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ON

THE NATURE AND TREATMENT

OF THE

DISEASES OF THE HEART:

CONTAINING ALSO AN ACCOUNT OF
THE MUSCULO-CARDIAC, THE PULMO-CARDIAC,
AND
THE VENO-PULMONARY FUNCTIONS.

Wm H Cammann

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TO

JAMES SIMPSON, M.D.

PROFESSOR OF MIDWIFERY IN THE UNIVERSITY OF EDINBURGH,

ETC., ETC., ETC.

I dedicate this Book to you, because I consider you to be one of the most distinguished Members of your Profession, and one of the greatest benefactors to mankind. Your untiring assiduity, your unwearying zeal, and the genius which you have shown in the advancement of the Healing Art, justly entitle you to the esteem of medical men; whilst the discovery of Chloroform, as a wonderful means of assuaging human sufferings, has gained for you the everlasting gratitude of your fellow-beings.

I am also glad to have an opportunity like the present to express the high sense which I entertain of your philanthropy, of your beneficence, and of your many private virtues; and it is a particular source of pleasure to me to think, that it should have been on the same spot of that land as yourself wherein I drew the first breath of life!

In offering to you this tribute of regard, let me express an earnest hope that you may long be enabled, by your precepts and by your example, to adorn a Profession with which the happiness and interests of humanity are so intimately associated.

JAMES WARDROP.

Charles-street, St. James'-square,
June, 1851.

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PREFATORY ADDRESS.

Before entering upon the consideration of the diseases of the heart, and in order to illustrate some important pathological phenomena connected with the circulation and respiration, I propose, in the present inquiry, to draw the attention of the reader to some points in the anatomy of the circulating apparatus, and to certain functions of the heart, which I have on a former occasion endeavoured to point out, and by a knowledge of which I am confident that many disorders, not only of the heart, but also of the respiratory and nervous systems, may be satisfactorily explained and rational principles for their treatment established.

Whilst prosecuting some investigations concerning the diseases of the heart, and more particularly regarding their causes and treatment, my attention was directed to certain symptoms with which various affections of that organ are accompanied; and, in seeking an explanation of them, I was led to reflect on several natural phenomena connected with the circulation of the blood in the heart, and with the function of respiration, of which no satisfactory explanation had been given, and to some of them no allusion had been made, in physiological writings.

I was particularly struck with the influence of respiration on the action of the heart, and with the influence of the action of the heart on respiration, as well as with all the modifications of these functions, not only in diseases, but likewise during the acts of weeping, sobbing, crying, laughing, sneezing, and vomiting, of all which scarcely any notice, far less any satisfactory explanation, is to be found either in physiological or pathological works.

I was also led to inquire how it is that the giddiness in turning round rapidly, in swinging, and sea-sickness should be experienced in some persons and not in others.

Having arrived at the conclusion that these various phenomena are intimately connected with the great function of the circulation of the blood, further observations convinced me that each of them is an instinctive act, employed for performing a specific purpose in the economy, some for increasing and others for diminishing the quantity of blood within the thoracic cavities, according as modifications in its quantity are required, or an adjustment necessary in the different organs for the due performance of their respective functions.

My attention was no less arrested when contemplating the influence which the almost constant movements of the body produce both on the respiratory and circulating organs. I was led to inquire how the action of the heart and lungs is increased by violent exercise; how persons can, by a process of "training," acquire the power of using their muscles, until the muscular energy is exhausted, without causing breathlessness or a sense of suffocation; in what the art of diving consists; and, finally, how diseases of the heart are caused by inordinate muscular exertions, as well as by violent mental emotions.

In pursuing these investigations, I was conducted step by step to establish three important functions—functions connected with the circulation of the blood, which had hitherto been overlooked by physiologists.

First, that the muscles, besides being the active organs of locomotion, powerfully influence the circulation in the arteries as well as in the veins, and thus perform the important office of increasing the quantity of arterial as well as of venous blood within the cavities of the heart.

Secondly, that the lungs, as a reservoir, regulate the supply of blood to the heart, so as to prevent congestion within the heart's cavities.

Thirdly, that the subcutaneous veins likewise perform the office of a reservoir, and prevent congestion of blood within the pulmonary vessels.

The first of these functions I have denominated the *musculo-cardiac*, the second the *pulmo-cardiac*, and the third the *veno-pulmonary* function.

By demonstrating these important functions of the organs of active motion, of the lungs, and of the subcutaneous veins, several phenomena, both of the respiratory and circulatory organs, will admit, I am confident, of a very satisfactory explanation, and will also enable us to account for some peculiarities in the structure and arrangements of the vascular system, whilst at the same time they will materially assist in elucidating many phenomena in the diseases both of the organs of circulation and respiration.

From the supposed dangerous tendency of all the diseases of the heart, it might have been anticipated that the various affections of that organ would have been carefully investigated, even from a very early period in the history of medicine; but the erroneous impression which has been too generally entertained of the limited powers of medical treatment, as well as of the fatal character of these diseases, would seem to have paralyzed rather than to have excited inquiry into this most interesting branch of medical science.

Morgagni, Senac, Baillie, Burns, and others, had contributed much to advance our acquaintance with the pathology of the heart; and the subsequent researches of the French pathologists, more especially those of Corvisart, Laennec, Bertin, Andral, and Bouillaud, by pointing out the additional means of recognising, during life, some of the morbid changes of structure which we had previously been able to detect only after death, materially contributed to the advancement of this department of knowledge. Still, however, it remains an important desideratum to discover the means of discriminating many of the diseases of the heart, more especially in their earliest stages, and before any of those formidable changes of structure have taken place, which it is not within the powers of medicine to control; for it is quite evident that such changes of structure must be preceded by a train of phenomena,—by a series of lesser disturbances in the function of the heart,—the detection of which would enable us to apply remedial means with a probability of achieving the same advantages as are derived in the treatment of diseases in other organs.

To these investigations my attention has been particularly directed, and I am not without the hope that the explanation which I am about to give of the nature and causes of some of the *functional* diseases of the heart, and the additions made to the catalogue of their symptoms, along with the principles laid down for their treatment, will not be deemed unimportant. It is, indeed, surprising, though no less true, that the functional disorders of the heart have met with scarcely any consideration from the numerous authors who have professed to treat of the diseases of this organ. "It appears to me," very justly observes Dr. Barlow, when alluding to the importance of attention being directed to functional diseases in general, "that to such early periods of disease attention may be most beneficially directed, and that, whilst we continue to avail ourselves of the accumulated experience of ages in treating the more advanced stages, it is incumbent on us to extend the boundaries of the science we profess by more completely investigating the earliest approaches, and thus illustrating those early and important periods of disease in which medical treatment may be of most avail."*

Of no inconsiderable importance will, I trust, be found the observations I am about to make on the general or *physiological* symptoms of the diseases of the heart, a subject on which too little attention has been hitherto bestowed; for though Laennec had the merit of throwing much light on the pathology of this organ, and of creating great zeal in others to pursue the same investigations, yet many of his followers seem to have been intoxicated with the idea of being able to form a correct diagnosis by observing merely the physical signs of the diseases of the heart, and to have almost entirely disregarded the physiological symptoms, or those symptoms which arise from changes in the various systems and organs of the economy, which alterations in their supply of blood must produce, and which are the necessary consequences of a disordered action of the central organ of the circulation.

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* "Edinburgh Medical and Surgical Journal."

The observations which I shall have to make on therapeutics will, it is hoped, merit the consideration of practical men; and those medicinal substances which have a specific effect on the action of the heart I have arranged together and formed into one class; for it is singular that, whilst classes have been assigned to sudorifics, diuretics, purgatives, &c. &c., no author has devoted one to those substances which act upon the organs of circulation.

Ipecacuanha, as is well known, acts upon the stomach, saline medicines on the small and aloes on the large intestines; mercury influences the functions of the liver and salivary glands; cantharides and the various balsams operate on the urinary organs; narcotics act on the brain, and some even on particular nerves, as, for instance, belladonna on those of the iris. In like manner, the preparations of antimony, of iron, of copper, of lead, and also certain vegetable substances, as digitalis, colchicum, hellebore, and tobacco, have each a particular influence on the functions of the heart. It is not, therefore, too much to affirm, that the power of recognising diseases of the heart in their earliest stages will, along with the judicious exhibition of these cardiac remedies, enable us to treat the diseases of that organ as successfully as those of any other viscus.

The materials of which these discourses are composed, I may observe, have been collected and arranged during those intervals of repose which are but sparingly allotted to those who are engaged in the anxious and laborious duties of a professional life.

Thus, I have been compelled to limit myself to the investigation of those diseases chiefly which I have had ample opportunities of observing, and to avoid dwelling upon such maladies as have been fully treated of by others; and however imperfectly some of the subjects are discussed, and however much, by time and industry, they might be made more worthy of being brought before the profession, yet I have a strong conviction of the danger of delay, and of the evil of being too anxious to render a work more perfect than circumstances are ever likely to permit. Impressed, too, with the uncertainty of human life and of the continuance of intellectual vigour, I am induced to offer the work in its present state, and must apologise for the numerous defects, and for the general manner in which some of the topics in it are discussed; for, although I have been long employed in collecting and condensing the materials of these pages, yet I am quite aware that, on a subject so comprehensive as that on which I profess to treat, with whatever industry I may be able further to prosecute it, the field of inquiry is far too extensive to be satisfactorily explored by any one individual.

Much indulgence may surely be with justice claimed by those who, towards the close of a long and busy life, devote a portion of their time to record the results of their experience and observation; and it is only to be regretted that, in a practical profession like that of medicine, so many of our most distinguished brethren have not left behind them even the most trifling memorial of all their labours; a circumstance much to be deplored in the lives of professional men, and which results, perhaps, too frequently from the desire which most of us feel to undergo less mental exertion and fatigue, and to enjoy more tranquillity and repose, as we advance in the vale of years!

CHAPTER I.

GENERAL OBSERVATIONS ON THE STRUCTURE AND FUNCTIONS OF THE HEART.

The number of the heart's functions; their peculiarities; variations in the capacity of the heart; the blood's transit through the heart; sounds caused by its currents; the two audible sounds; the tilting of the heart explained; the impulse caused by it; changes in the position of the heart; the muscles of the heart; peculiarities in their structure and functions; the yellow fibro-cartilaginous structure; the chordæ tendineæ; the pericardium and the endo-cardium; the coronary arteries and veins; the cardiac nerves; the heart alone not sufficient to circulate the blood; organs employed besides the heart; the arteries, the capillaries, the veins, the muscles, the lungs, and the nervous system.

The number of its functions.

Their peculiarities.

John Hunter

The heart performs no less than four distinct functions, for each of which a special apparatus is assigned. As a reservoir, it receives the blood within its different cavities; it propels the blood into the arteries like a syringe; it mixes the two bloods which it receives from the venæ cavæ like a churn; and it also directs the vital fluid into the proper channels by the peculiar form of its internal surface, the position of its valves, and the "tilting" of its apex. It is neither an organ of secretion nor of excretion; and there is scarcely any other whose functions are so purely mechanical as those of the heart. "The heart is truly a mechanical engine: for, although the muscles are the powers in an animal, yet these powers are themselves often converted into a machine, of which the heart is a strong instance. For, from the disposition of its muscular fibres, tendons, ligaments, and valves, it is adapted to mechanical purposes, which make it a complete organ or machine in itself." But, in contemplating the phenomena of the circulation, we must, at the same time, be cautious in discriminating those functions which are purely physical from those which are vital.

The capacity of the heart varies.

The *capacity* of the cavities of the heart changes much in the varied conditions of the circulation, and they certainly expel and receive more blood at one time than at another, the velocity of the streams being increased or diminished according to the heart's vigour.

The blood's movements through the heart.

But in the healthy circulation it is evident that precisely the same quantity of blood which the ventricles expel into the arteries will enter the auricles by the veins, so that the whole mass of the vital element forms one great circle. And, although the quantity of blood leaving and returning to the heart is always the same, yet the momentum with which it is expelled and returned to the central organ must differ according to the comparative calibre of the two systems of vessels—the venæ cavæ and the aorta; for not only is the aggregate area of the two sets of vessels very different, but the various modes by which the veins and arteries ramify and anastomose must change the velocity of the blood's currents in the different parts of the system. And these differences in the circulation, differences required for the due performance of the natural functions of the economy, all become variously modified in diseases.

Sounds caused by it.

In its passage through the irregularly formed cavities of the heart the blood necessarily flows in a variety of currents, and these currents produce *sounds*, two only of which are perceptible to a common ear.

The two audible sounds.

The audible sounds vary in different conditions of the healthy subject, differing in intensity and in duration. In some individuals they are sharp and acute, in others they are more or less dull, or even scarcely audible. The "first" sound is usually flat, whilst the "second" sound is sharper, clearer, and shorter than the first.

The two sounds are perceived to follow each other in rapid succession, after which there is a pause, and the proportions in the intervals between the sounds are variously altered in diseases.

The sounds, too, become altered in their intensity whenever any change takes place in the thickness or density of the parietes of the heart, in the form of its cavities, or in the valvular apparatus. They may likewise be altered, from changes in the structure of the parts surrounding the heart; and they may be changed in duration, only one of the sounds altered, the intervals between them changed, or entirely new sounds produced.

Changes in the sounds from diseases.

Changes in the sounds, therefore, become diagnostic signs in diseases of the heart, and, when taken along with the physiological symptoms, form a useful addition to Semiology.

The tilting of the heart.

The alternate contractions and relaxations of the muscular parietes of the heart cause in it a very considerable movement, the apex being "tilted" upon the parietes of the chest; and to admit of this motion there is a particular structure assigned, the mode by which the aorta and pulmonary artery are united to the ventricles forming a kind of hinge, which readily admits of the tilting.

Jeffery's Observations on the Heart.

"The walls of the aorta and pulmonary artery, from the upper edge of their imbossments or sinuses, down to their origin in the tendinous brim of the ventricular foramen, turn gradually thinner, more limber, and less elastic than anywhere else." And this thin and less elastic condition of the root of the aorta and pulmonary artery is a structure evidently intended to admit of the heart's movements, and by which both the bloods will flow more readily, and in a rectilineal direction, into the great arterial trunks.

The opposite position of the apex of the heart, which takes place when the ventricles are replenished with blood, will favour the entrance of the venous and the pulmonic bloods into the auricles, in like manner as the exit of the systemic blood is facilitated by the tilting of the apex; and the thin coats of the veins are equally calculated to permit them assuming a more rectilinear form when the attitude of the heart is thus changed.

The impulse is caused by the tilting.

It is chiefly this tilting of the heart which gives the shock to the walls of the chest—more technically called the *impulse*—so evident to the sense of touch, though varying in its intensity from peculiarities in the natural form or in the thickness of the walls of the chest; from differences in the bulk of the heart, from differences in the vigour of the circulation, and likewise from different positions of the body.

As the impulse is a measure of the intensity of the blow given to the parietes of the thorax by the tilting of the heart's apex, and as the blow of the apex is a measure of the strength of the ventricular contractions, hence physicians have always deemed the impulse of the heart as a test of the vigour of the circulation.

Changes in the position of the heart.

Loosely suspended by the great arterial and venous trunks in the cavity of the pericardium, the heart likewise admits of considerable changes in its *position*, from changes in the position or in the form of the adjacent viscera.

"The heart rolls about in the thorax. We turn to our left side in bed, and it beats there; we turn over to our right side, and the heart falls back into the chest, so that its pulse is nowhere to be perceived; we incline to our left side again, and it beats quickly and strongly. The heart is raised by a full stomach, and is pushed upwards in dropsy; and during pregnancy its posture is remarkably changed: it is suddenly depressed again when the child is delivered, or the waters of a dropsy are drawn off. It is shaken by coughing, laughing, and sneezing; and, by matter collected within the thorax, the heart may be displaced to any degree."

John Bell's Anatomy.

The muscles of the heart.

Destined to propel the blood, not only to the lungs, but throughout the whole system, the muscular structure of the heart forms one of the most essential ingredients in its composition. The *muscles* are generally more firm and more elastic than other muscles, and the fibres of which they are composed are more compact, being separated only by a very delicate cellular tissue. They are also enclosed in a firm capsule, and are formed, like other muscles, into bundles.

Wolf, Duncan, Gerdy, and Bertin.

These bundles are again formed into layers, the left ventricle having six, and the right ventricle having three, distinct laminæ; whilst the auricles have only two layers, and the left auricle has more muscular fibres than the right.

The two ventricles and auricles are suited, in point of strength, to the different office in the circulation each performs. Hence the comparative differences in the thickness of the right and left ventricles and auricles in diseases of the heart.

Peculiarities in their structure.

The muscles of the heart are also remarkable for having a greater number of blood-vessels, when compared with those of other muscles, an additional quantity of blood being required to enable them to perform their unceasing actions.

Excited to contract by the blood.

The heart's muscles are excited to contract by the blood, in like manner as the muscles of other organs are stimulated by the respective fluids which are naturally in contact with them, as is exemplified in the alimentary canal and urinary bladder.

Wilson's Lectures on the Vascular System.

And a great peculiarity in these muscles is, that the rhythmic contractions of the different cavities of the heart go on in their regular order, even after the heart is removed from a living body and emptied of its blood.

Their actions are unceasing.

Haller's First Lines of Physiology.

There is one essential difference in the functions of the muscles of the heart from those of all other organs, excepting those of respiration: they have no repose, their unceasing action being absolutely necessary for the continuation of life. "How is it," says the illustrious Haller, "that the heart, with its incessant motion during so many years as there are in a lifetime, during so many days as there are in a year, and when in each hour it contracts not much less than five thousand times, never resting, but contraction perpetually succeeding repletion,—how is it that the heart is neither fatigued nor pained by so excessive an action,—an action which no other muscle could endure even for a few hours?"

Their diseases frequent.

Now, it is these differences in the function of the heart's muscles to which I think may be attributed many peculiar features in the diseases of the heart; and it is also this muscular part of its structure which is so frequently affected.

It is easy to comprehend how, when the muscles of the heart have been excited to inordinate action, the circumstance of their having no repose to enable them to recover the effects of fatigue must, sooner or later, create changes in their structure, as well as in their function—changes which do not occur in muscles which are placed in a state of perfect rest for some time after violent exertion. And hence, as will afterwards be pointed out, when the heart's muscles have been over-excited or fatigued,—a circumstance which is often taking place,—they require a distinct system of treatment.

This unceasing action of the heart has, likewise, as might have been anticipated, a great influence in modifying the diseases of all those structures which enter into its composition; for, when either the external covering or internal membrane becomes in the slightest degree inflamed, that inflammation cannot fail to be increased by the unremitting action of the muscles.

The yellow fibro-cartilaginous structure.

See Appendix (A.)

In the composition of the heart there is a considerable quantity of the *yellow fibro-cartilaginous* substance, similar to the fibrous coat of the arteries. This structure commences at the roots of the large vessels, where they emerge from the heart's cavities; and by its elasticity it assists these cavities alternately to expand and contract, and thus to accommodate themselves to the constant changes in the quantity of blood propelled into them.

The chordæ tendineæ.

The *chordæ tendineæ* also form a distinct ingredient in the heart's composition, assisting in mixing the blood, and in giving, by their action on the valves, special directions to the different currents; and some of these columns are so placed as to serve the purpose of preventing the cavities of the heart from being over-distended.

The external and internal membranes.

Besides the muscular, fibro-cartilaginous, and tendinous tissues which enter into its composition, the heart is covered externally by a capsule, or *pericardium*, and its cavities are lined with the *endocardium*, membranes which, though they are in some respects analogous, must not be strictly compared to each other, either in their structure, their functions, or in their pathological conditions.

The pericardium—its structure.

"The pericardium," according to Bichat, "is composed of two distinct structures, and, although they are found in a great measure united and identified, the general disposition of both is so different, their nature, their properties, their uses, distinguishing them so remarkably, that it is absolutely impossible to describe them together, and to consider the pericardium as a single organ when we examine its anatomical details. Of these structures the exterior is *fibrous* and the interior is *serous*."

Anatomie Générale, par Xav. Bichat.

Its different offices.

The offices which the *pericardium* performs are twofold, affording on the one hand a smooth and moistened surface, not unlike that of a *bursa*, in order to facilitate the constant motions of the heart upon the adjacent parts; and, on the other hand, being a very dense and strong membranous bag, it, by its connections with the mediastinum and the diapraghm, suspends the heart and prevents its being displaced during its unceasing movements, or *tilting*, or by changes in the form and position of the adjacent viscera.

Its changes in disease.

In its diseases the interior surface of the pericardium offers a strict analogy to those of other *serous* cavities, as the pleura, peritoneum, and membranes of the brain; its surface being covered with coagulable lymph, the fluid which its surface exhales being increased in quantity, and the membrane itself increased in thickness by an attack of inflammation; whereas its *fibrous* lamina, as other fibrous tissues, is in all probability affected by rheumatism.

The endocardium—its structure.

Traité sur les Membranes.

Though the membrane lining the heart and arteries bears a certain analogy to, and has been classed by the ingenious Bichat amongst, the *serous* membranes, yet there are peculiarities in its structure and functions, as well as in its pathological conditions, which are not found in the other membranes of that class. Like all *serous* membranes it has a surface intended to facilitate the motions of certain parts on one another; yet it might be expected that the same peculiar structure of its surface as the serous membranes have would not be requisite, or would not be adequate, for the movements of the intestines upon each other, or of the surface of the lungs upon the pleura, or of the brain upon the cranium. Hence we find that, as the lining, not only of the cavities of the heart, but of the whole sanguineous system, is intended for the transit of the blood with as little friction as possible, the surface of this tunic is remarkable for its smoothness and polish. At the same time the lining membranes of the arterial and venous systems are somewhat different, that of the venous system being thinner, having greater powers of extension, and being less brittle and less easily torn than the inner coat of the arterial system.

Its peculiarities.

Neither does it appear at all improbable, from the office required of this tunic of the vascular system, that there is any fluid exhaled upon it, no moisture being requisite to render the flow of the vital stream easier along the highly-polished and slippery vascular canals ; in this respect, being unlike the pericardium, pleura, or peritoneum, these surfaces are moistened in order to prevent the friction of solid substances upon one another.

Its changes in disease.

The most remarkable feature, and in which this membrane differs from all other serous membranes, in its diseases, is the patches or stains, of a bright scarlet colour, that are so frequently found upon it, and which cannot be traced either to an increased vascularity, as no distinct vessels can be detected in it, nor from the effect of *imbibition*, for it cannot be imitated by macerating an artery in blood.

There is also to be observed a striking difference in the quantity of effused lymph in the interior and exterior membranes of the heart and aorta, when these have been inflamed, as we seldom or never find those large masses of coagulated lymph effused in the cavities of the heart, or upon the surface of the aorta, so constantly met with in *pericarditis ;* and, although there may be an exudation of coagulable lymph from the inflamed *endocardium*, it is probable that more or less of it will be washed away by the stream of blood which is constantly passing over it.

On reviewing what has been now said of the peculiarities in the structure, functions, and morbid changes of the lining membrane of the vascular system, it appears to me that it is a tissue *sui generis*, and ought not to be considered simply as a serous membrane.

There is also upon the exterior of the heart a quantity of *adipose* substance, the uses of which have never been explained, and all we know is, that, unlike the rest of the body, it is usually met with in the largest quantity upon the hearts of the thinnest people, and none of it is found on the hearts of wild animals.

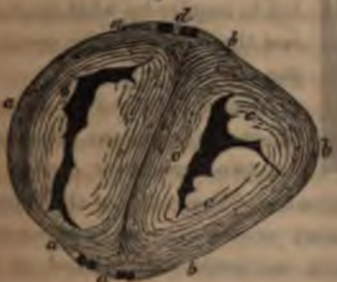
The arteries of the heart.

The *coronary arteries* of the heart are not only of larger dimensions than other arteries, in proportion to the bulk of the organ which they supply, but they present a striking peculiarity in their origin and in their course. These arteries arise from the root of the aorta in such a manner that, under all circumstances, the free entrance of the blood into them cannot be interrupted. In consequence of their mouths opening into the "lesser sinuses" or pouches of the aorta, the current of the blood ejected from the left ventricle is not able to press the semilunar valves against the sides of the aorta, so that the flow of blood is not impeded into the coronary vessels; and, likewise, as the semilunar valves are kept in the middle of the current of the retrograde blood, the orifices of the coronary arteries are constantly open, and thus the supply of blood to the heart is never interrupted.

See Appendix (B).

In their course, the coronary arteries exhibit a great peculiarity, described by Professor Jeffrey, and to which I shall afterwards have occasion to refer, when pointing out the influence of muscular contractions upon the circulation in arteries. These vessels, in place of being encircled by, or intermingled with, muscles, pass along the tendinous and deep grooves which separate the auricles from the ventricles; and by which simple contrivance neither the arteries nor the accompanying veins can suffer any compression to interrupt their circulation, either from the auricular or ventricular contraction.

Fig. 1.



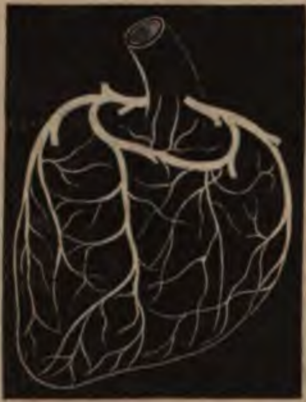
In the vertical section of the heart represented in Fig. 1, the relative position of the cardiac vessels and muscles of the ventricles are drawn, by which it is evident that neither their contraction nor relaxation can have any influence on the transit of the blood. (*a, a, a*), the muscular parietes of the right and (*b,b,b*), the parietes of the left ventricle. (*c, c*) and (*d, d*) are the mouths of the right and left coronary arteries and veins.

The two coronary arteries supply with blood not only the muscular structure of both auricles and ventricles, and the coats of those portions of the large arterial trunks which are within the pericardium, but some of their branches are reflected on the aorta and pericardium itself. These branches also inosculate with branches of the internal mammary and bronchial vessels, thus establishing a vascular connection amongst the different structures of the heart—a connection which is exemplified in many diseases.

The coronary arteries inosculate very freely with one another, and the surface of the heart is covered with a prodigious number of minute branches injected and beautifully delineated by Ruysch.

In the accompanying diagram some of the most important branches of the coronary arteries and their principal anastomoses are represented.

Fig. 2.



The coronary veins.

Having shown the contrivances by which the coronary arteries provide the structure of the heart with a constant supply of blood, we are next led to inquire by what mechanism the *coronary veins* carry on the venous circulation,

Their structure.

Although there is a regurgitation of the venous blood into the two *venæ cavæ*, caused by the contractions of the right auricle, any reflux of the venous blood into the great coronary vein is completely guarded against, that vessel having a semilunar valve placed at its mouth. By this mechanism no venous blood can pass from the auricle into the vein during the auricular contractions; and at the same time a provision is made by the *sinus venosus* for receiving whatever blood may flow into the great venous trunk during the closure of its mouth. This sinus, or enlargement of the coronary vein, seems to me to perform here the office of a *receptaculum*, being so placed in relation to the ventricle and auricle that their systole and diastole cannot influence its circulation, and receiving the blood coming from all the venous branches into the great trunk, until its mouth is again opened by the auricular diastole; and thus any over-distention of the veins in the substance of the heart is carefully guarded against—a circumstance which would inevitably take place was there no sinus.

The sinus venosus—use of.

From the arrangement of the coronary vessels it may be readily understood how disturbances in their functions should be materially affected when the cavities of the heart become congested, or when morbid changes are going on in its different structures: subjects which have hitherto excited but little attention from pathological inquirers.

In general, throughout the system, it may be observed, that the blood in the veins flows in an opposite direction to that in the arteries, so that the two streams of blood are, as it were, opposed to each other. But, in the heart, the current of the blood in the large branches of the coronary veins, which vessels are placed alongside the coronary arteries, runs in the same direction with the blood in the arteries.

Jeffery's Observations on the Heart.

See Appendix (C).

The heart has a smaller proportion of *nerves* than some other organs; and these, being derived both from the great sympathetic and *par vagum*, explains the influence which the mind exercises on the heart, as well as its sympathies with the respiratory and digestive apparatus.

The nerves of the heart.

Independently of such diseases as are confined either to the pulmonic or systemic heart, each of the heart's structures is liable, as similar tissues in other organs into the composition of which they enter, to be affected separately, or they may be all involved in one disease; and, whenever any part of the structure of the heart is changed, some of its

Its diseases.

functions become disturbed, and various alterations necessarily take place in the distribution of the blood. If, for example, from any alteration of structure, the blood cannot readily pass from the right auricle into the right ventricle, or from the right ventricle into the pulmonary artery, it will be naturally anticipated that either of these changes will produce some irregularity in the distribution of the *venous* blood. So, also, when, if either the left auricle or the left ventricle cannot propel the blood in its natural current, or with its usual velocity, a variety of symptoms will arise from a disturbance in the circulation of the *arterial* blood.

Heart alone not sufficient to circulate the blood.

On contemplating the structure and function of the central organ of the circulation, for the purpose of elucidating the nature of its various diseases, it is essential that our researches should not be limited to the function of the heart alone, but that such inquiries should be extended to those organs which are intimately associated with the heart, and which materially contribute to the circulation of the blood.

Though it may be strictly true that the blood flows in a circle, and that the heart, like a syringe, has sufficient muscular power to propel the vital fluid throughout the whole system, there are other physical conditions necessary for the due performance of that important function—conditions to which we must constantly refer in all our pathological researches.

Variations of the supply of blood to different organs.

It is not only indispensable that a certain quantity of blood be sent to every part of the body, but that the supply to the different organs be variously modified. In some it is requisite that such supply be more equal and uniform, whilst in others it is necessary that on certain occasions the quantity of the vital fluid be either diminished or increased.

Supply to the brain uniform;

to the stomach varies;

Of the first of these conditions there is an example in the *brain*, for the due performance of whose functions the supply of blood must be uniform; and of the other we have an illustration in the *stomach*, to which viscus, during the process of digestion, the quantity of blood is more or less increased.

Another illustration of a temporary change in the quantity of blood supplied to particular organs is afforded in the *erectile* tissues, those structures being employed in certain parts for the sole purpose of altering their form, in order to enable the organs to which they belong to perform a particular function. Hence the erectile tissue of the nipple becomes injected with blood, to enable the infant to withdraw the milk from the lacteal tubes.

and to the erectile tissues.

Organs employed in the circulation besides the heart.

For thus modifying the distribution of the blood in the various organs, we shall find that, besides the influence of the nervous system, there are employed no less than *five* other organs as well as the heart: the arteries, the capillaries, the veins, the muscles or active organs of motion, and the respiratory apparatus. The co-operation of these different organs for carrying on the circulation of the blood when the body is in health renders it essential, in prosecuting our pathological researches, that the share which each of them has in executing that important function should be separately considered; for it is evident that, as the healthy circulation depends on the due performance of the natural functions of these different organs, so it will happen that disorders of the heart must modify their functions; and, on the other hand, changes in their functions will influence the functions of the heart.

Function of the arteries.

The *arteries*, whether by an elastic power alone, or by elasticity and muscularity combined, lend the heart an important aid in conveying the blood to the capillaries. I have already stated that it is not requisite that the blood should be transmitted to all parts of the body with the same velocity, or that the supply to the different organs be at all times uniform. These purposes, as well as to provide for the exigencies which certain organs may demand, when, from our habits or avocations, the circulation becomes disturbed, are all fulfilled by particular modes in the *distribution* of the arteries. And the coats of the arteries are beautifully contrived by their elasticity to admit either of an increase or of a diminution in their calibre, in order to accommodate themselves to the constant changes which are taking place in the currents of the vital stream.

As, therefore, the heart, though it has the power to circulate the blood, has not the power to direct any extra quantity of blood more to one part of the body than to another, that office must be performed by changes in the functions of the proper vessels of the organs,—their *vasa propria*,—influenced and regulated by the nervous system.

Differ in their modes of distribution.

The *length* of different arterial trunks,—the different *angles* at which the branches leave the trunks,—the varieties in the course of arteries,—the *tortuosities*,—the different modes in which they *ramify*,—the *anastomoses* and *plexuses* of arteries, are all peculiarities of arrangement which we find in the arteries, and which are calculated to modify the circulation of the blood in particular organs.

Differences in their length.

Their tortuosities.

A remarkable difference in the *length* of arteries, as well as in the *angle* by which they come off from the trunk, is exemplified in the renal and spermatic vessels; whilst the carotids and vertebrals, the arteries of the uterus and of the spleen, are each examples of *tortuosities* in the distribution of arteries, obviously intended either to modify the momentum of the blood, or to ensure a regular supply to particular organs.

Their anastomoses.

The *anastomoses* of arteries, such as that formed by the coronary vessels of the heart, stomach, and lips, and by the arteries of the iris, and likewise the free inosculation between the carotids and vertebrals established by the basilar, are all modifications in the distribution of arteries, which serve the essential purpose of preventing any interruption to the necessary supply of blood to the respective organs.

See Appendix (D.)

And, although the heart propels the blood with a certain velocity to the smaller branches of the arteries, the modifications in the circulation produced by their numerous anastomoses in many parts of the body must diminish to a greater or less degree the blood's momentum.

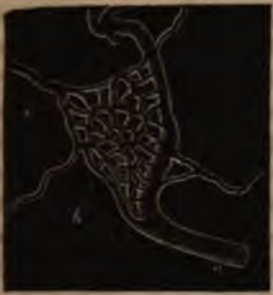
Plexus of arteries.

The arterial *plexus* found in man, and which is still more remarkable in some organs of the lower animals, is a mode of arteries ramifying which fulfils an important office in the circulation.

The *Rete Mirabile* of Hovius.

The plexus of the ophthalmic artery in some birds prevents the pressure of the column of blood on the visual organs when these animals are under water with their heads placed downwards in search of food.

Fig. 3.



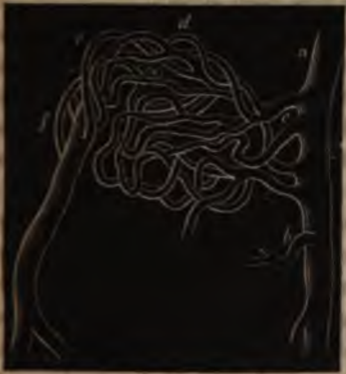
(*a*, *a*) Branches of the carotid artery, from which is derived the plexus. (*b*) The plexus, of a triangular form. From its base innumerable small branches arise, and which unite at the opposite angle (*c*).—Hovius.

The *Rete Mirabile* of Galen.

In the graminivorous animals, whose heads are kept so constantly in a depending position whilst feeding, a like purpose is served by a plexus of the internal carotid artery.

Fig. 4 represents, in a fœtus calf, the plexus formed by the internal carotid artery, called by Galen the *rete mirabile*. (*a*) is the top of the common carotid artery, (*b*) the external carotid arteries, (*c*) several arteries which supply the place of the single internal carotid in man, (*d*) numerous small serpentine branches into which these arteries are subdivided in their progress through the cranium, (*e*) these branches joining again into (*f*), the principal trunk of the internal carotid artery within the head, and which afterwards divides into branches, resembling those in man.—Monro.

Fig. 4.



The intercostal plexus in aquatic animals.

Some aquatic animals, whose habits render them subject to great vicissitudes of pressure, from the depth of the waters in which they occasionally dwell, are also provided with a special apparatus, or *rete*, in the organs of circulation, which appears to me to be intended to guard them against the pernicious effects of that congestion which would otherwise be caused by the stoppage of the circulation in the exterior of the body. In the whale, dolphin, and other cetaceous fishes, the intercostal arteries form a very extensive plexus, these vessels dividing into many tortuous branches, which again reunite; so that when the animal descends into very deep water, as its necessities require it to do, the pressure of the superincumbent medium must diminish, and even retard altogether, the blood's flow into the exterior vessels of the body, causing it to accumulate within the great cavities, more especially the chest. It will then collect in the vascular network, as in a reservoir, from which it will again flow to the surface of the body whenever the animal emerges from the deep.

See Phil. Tr., 1734.

This arterial plexus was first described by John Hunter, and subsequently a more detailed account has been given by Brechet, though he has attributed to it a very different use in the economy from what has now been given.

See Histoire Anatomique et Physiologique d'un Organe Vasculaire dans le Cétace.

Some organs supplied with several trunks.

To accomplish a similar purpose in the circulation, some important organs are supplied with vessels from several trunks, as the brain, with its two vertebral and two carotid arteries, the stomach, with its branches from different trunks, and the eye, with branches both from the internal and external carotids.

The capillary system.

The *capillaries*, too, co-operate with the heart and arteries in carrying on the circulation, and more especially for regulating and modifying the quantity of blood required for particular organs. At the same time, the capillary circulation is independent of the general circulation, of which we see abundant proofs in the temporary flushes of the cheeks, and in the redness of particular portions of the skin. And, when a finger is inflamed, the diseased action appears to be first limited to the cutaneous capillaries; and only when the inflammation has arrived at a certain degree of intensity does the arterial system, and subsequently the heart itself, become influenced.

The functions of the capillaries are greatly modified by the condition of the heart, and the action of the heart is equally modified by the capillaries; and so intimately associated are these two portions of the sanguineous system, that, whether in acute or chronic disease, it is seldom found that there is any serious disturbance in the one without a corresponding change in the condition of the other.

The venous system.

Although the offices in the circulation which the *veins* perform are quite subservient to those of the arterial and capillary systems, being chiefly employed to return to the heart the blood, after it has undergone certain changes in the organs of secretion and excretion, mixed with the chyle, and arterialised in the lungs, there are, likewise, several distinct functions performed by different subdivisions of the venous system, and also by the veins of some organs.

The subcutaneous veins.

For these purposes there are particular arrangements The *subcutaneous* veins are placed externally to the muscles, and have numerous valves to prevent any regurgitation of the blood that might be occasioned by external pressure or by the contractions of the subjacent muscles, whilst the *intermuscular* veins are placed in sheaths along with the arteries, and are in such relation to the muscles that they are completely under the influence of their contractions.

The *venæ comites*.

The comparative number of veins and arteries.

In number and size the veins, compared with the arteries, also differ exceedingly in different parts of the body. The size of the pulmonary veins scarcely surpasses that of the pulmonary artery, and in the intestines the number of arteries and veins is nearly equal; but in the cerebro-spinal and portal systems their number, compared to that of the arteries, is very considerably larger.

The tortuosities of veins.

The *tortuosities* of the veins of the uterus and testis also present peculiarities of the venous system; and, however inexplicable the office of the tortuosities may be, they must have a considerable influence, and co-operate along with the heart, arteries, and capillaries in the important office of the circulation of the blood in the respective organs.

The circulation also modified by vital causes.

But the office either of diminishing or of increasing the quantity of blood in certain parts of the body at particular times is a function of the circulation not depending alone upon the heart, but on the *nervous* system. When, for instance, food is taken into the stomach, its vessels become more replete with blood. When the intellectual powers are excited, an additional quantity of blood flows into the brain; and so also with regard to the erectile tissues of the *corpora cavernosa* and the vessels of the uterus and testes, whenever these organs are called upon to perform their respective functions.

In like manner we shall find that the heart itself requires a different quantity of blood in its various conditions; and it becomes an interesting subject of inquiry to discover how that supply of the vital fluid to the heart is always furnished with the requisite regularity;—a function which I shall endeavour to demonstrate is performed by the *muscles* or organs of active motion.

CHAPTER II.

THE MUSCULO-CARDIAC FUNCTION.

The musculo-cardiac function explained; some organs perform several different functions; influence of muscles on the circulation; they accelerate the return of the venous, and impede the exit of the arterial, blood; some muscles employed to compress arteries; some arteries are exposed to, and others protected from, muscular pressure; why veins accompany only some arteries; influence of muscular contractions on the vasa propria of muscles; anatomy of the vertebral and spinal arteries; anatomy of the carotid arteries; erroneous opinions of the use of tortuosities of the cerebral arteries; phenomena explained by the musculo-cardiac function; these phenomena enumerated; influence of the musculo-cardiac function on diseases of the heart; many symptoms explained by it.

The simplicity of Nature's works.

However difficult it may hitherto have been satisfactorily to explain any of the phenomena of living bodies, yet, whenever a step has been gained in physiological science, we are struck with the remarkable simplicity in the means which Nature employs for accomplishing what had to us appeared a most complicated function in the animal economy. In endeavouring, therefore, to explain any of those phenomena of living beings which have hitherto evaded research, it may be anticipated that, if such inquiries be successful, they will not lead to the discovery of *new* laws, but probably unfold the same simplicity of means for performing those operations of the economy which have already been disclosed by human intellect. It has, indeed, been justly observed, in allusion to the progress of chemical science, that it has shown "from what a small store of primitive materials have all that we behold and wonder at been created!" Chenevix. And in like manner it appears that, as physiology has advanced and we have been able to explain any of the phenomena of living animals, the laws which govern them are found to be equally few and simple; so that it is by no means improbable that some such general law as that of *gravitation*, which governs inanimate matter, may yet be discovered to govern and regulate all the phenomena of organised beings!

Some organs perform several functions,

In the arrangements of the animal economy it may be frequently observed that one organ is destined to perform several distinct functions—functions, indeed, in some instances so dissimilar and apparently so unconnected with one another, that it could not be well anticipated that they should be executed by the same physical apparatus. Thus, for example, the muscles of the jaw are not only employed to masticate the food, but they at the same time, and by the same muscular effort, evacuate the salivary glands, squeezing the saliva into the mouth by the pressure which they produce during their contractions on the salivary apparatus. The urinary organs of the male, moreover, are employed for the transmission of the seminal fluid, as well as to afford a passage for the urine. And the bones not only support the body like a framework, but they afford fixed points for the origin and insertion of the various muscles, and also form walls of defence for the internal organs, as the brain and the thoracic and pelvic viscera.

as those of mastication

and those of urine,

and the bones,

and the organs of respiration,

The functions of the respiratory apparatus are still more multiplied. Besides arterialising the blood, conveying odorous substances through the nasal passages to the organ of smell, assisting the return of the venous and expelling the systemic blood, and producing the voice, they also, as I shall subsequently endeavour to demonstrate, are employed in modifying the supply of blood to the heart. In birds we find that the functions of the respiratory apparatus are even more numerous, the air passing into membranous sacs within the chest and abdomen, as well as into their hollow bones, in order to assist their flight.

and the muscles.

In like manner we shall find that the voluntary *muscles*, besides being the active organs of motion, destined to perform the various movements of the body, are essential auxiliaries in the circulation of the blood, in the *arteries* as well as in the veins, performing both these offices merely by the pressure which they produce during their contractions upon the adjacent vessels. And further, when such muscular efforts are required, an additional vigour being at the same moment wanted for the heart, this office is performed by the same muscular contractions which are employed to accomplish the effort; and thus it is wisely constituted that the very same organs which perform the movements, and necessarily cause a certain degree of exhaustion, are also the means of invigorating the heart itself.

The muscles aid the systemic circulation.

Evidence of comparative anatomy.

A general view of the means by which the circulation of the blood is carried on throughout the animal creation, as well as the phenomena of diseases, will serve to point out the errors of those physiologists who have endeavoured to explain the *systemic* circulation by the action of the heart alone. The momentary flushings of the cheek, and the diseased changes in the cutaneous capillaries of a common pustule, might surely have been deemed sufficient to show that these vessels are endowed with powers and perform functions in the circulation which are independent of the central organ; and the fact that the circulation of the blood is carried on in some of the lower animals, as in *worms*, which are without a heart, only by the almost incessant motions of their bodies, might surely have indicated that muscular contractions have at least *some* influence on the circulation of the blood in the arteries as well as in the veins.

So important, indeed, is the influence which the muscular movements have on the circulation of the systemic blood, that in various tribes of animals the heart is found developed more and more perfectly in proportion as the body is less exposed to motion. Hence the restless *insect* requires no heart to impel its blood, whilst the *shellfish*, fixed and motionless on its rock, is provided with a central organ or heart, to carry on the circulation. In man the duty required of the heart must therefore vary considerably with his bodily pursuits, the sedentary habits of some preventing it from deriving little or any assistance from the organs of locomotion, whilst the active occupation of others will materially aid the circulation of the blood.

Muscles accelerate the return of the venous blood.

When the respiratory apparatus is healthy, and the circulation through the right heart undisturbed, the pulmonary veins afford a sufficient supply of arterialised blood to the left heart for the ordinary purposes of the systemic circulation. During sleep this must be strictly true; but if the heart is suddenly required to act with an additional vigour,—a circumstance which is constantly taking place whilst we are awake,—an increased supply of blood then becomes necessary, the energy of the heart depending on the quantity of blood with which it is supplied. This important office we shall find is fulfilled, not only by accelerating the flow of the venous blood into the right heart, but, as I shall endeavour to show, also by *impeding* the exit of the arterial blood from the left heart, both which purposes are admirably effected simply by the change of form which the muscles undergo during their contractions.

See Appendix (E).

That the velocity of the circulation in the veins of the extremities is accelerated by the contraction of the muscles of the limbs, and consequently that muscular exertions assist in propelling the venous blood towards the right heart, is a fact long since pointed out and generally admitted by physiologists. It was considered by Haller, and has never been contradicted by subsequent writers, as alone sufficient to explain both the increase in the heart's action and the frequency of respiration which follow muscular exertions.

Muscles impede the exit of the arterial blood.

But whilst it was demonstrated that the pressure caused by muscles during their contraction propels the blood onwards in the contiguous veins to the right heart, it seems never to have been contemplated what must be the effect of that same compression on the adjacent *arteries*, although these vessels are doubtless alike exposed to its influence. It will be my object in the future pages to show that the effect of muscular contractions, both on arteries adjacent to, as well as on those imbedded in, the substance of muscles, must be to compress these vessels, by which compression the flow of blood through them will be more or less impeded; and it will then appear that the contraction of muscles increases the accumulation of blood within the heart in two ways,—by *accelerating* the flow of the venous blood to the right heart, and by *impeding* the exit of the arterial blood from the left heart.

If, therefore, by the contractions of muscles, the free passage of the blood be impeded in any particular arteries, such as in those imbedded in the muscles of the limbs, there must take place a corresponding obstruction to the exit of the arterial blood from the left ventricle, and likewise an increased impetus to the blood in those arteries whose branches are not compressed. And in estimating the legitimacy of this conclusion, it ought to be borne in mind that the arterial tubes are all so completely filled with blood as to constitute, as it were, a solid yielding column; and consequently a pressure, however slight, made upon one part of it must be instantly felt throughout the whole arterial system.

See Appendix (F). Hyslop's Observations,

Mr. Hyslop, having bled a lady to syncope, became alarmed at its long continuance; and, on accidently raising her from a horizontal position, firmly grasping her arms and supporting by them the weight of the body, she rapidly recovered. Surprised at this, more particularly as the change from the horizontal to the erect posture might have been expected to have an opposite effect, Mr. Hyslop was led to reflect what could be the cause of so sudden a restoration of the heart's action in this instance; and he became convinced that, whilst elevating the body, and allowing its weight to be supported on that part of the arms along which the brachial arteries pass, he must have compressed those vessels, the effect of which compression would be an impediment to the flow of blood through them, and consequently an increase in the quantity of blood in the heart. He thence concluded that the rapid recovery of this patient from syncope must be analogous to the artificial process of transfusing blood. Subsequent experiments enabled him to prove the accuracy of his observations. He found that by the application of a tourniquet on the brachial artery he could increase the heart's action about ten pulsations in five minutes, an ingenious mode, which he afterwards proposed

and his experiments.

to adopt in order to revive the heart in cases of syncope or apparent drowning.

Additional illustrations.

This interesting observation, as I shall endeavour to show, leads not only to a satisfactory explanation of some phenomena of the circulation, but in particular it proves how the quantity of *arterial* blood, and, consequently, the vigour of the heart's action, are increased by muscular exertions; and it seems remarkable that, although Parry, Kellie, and other ingenious men had employed artificial means for compressing arteries in order to relieve some diseases, yet they never seemed to have contemplated what would be the effect of muscular contractions on the circulation of the adjacent arteries, and of their influence upon the recent circulation. Indeed, without being able to give any explanation of so curious a result, it is narrated that some French conscripts had been in the practice of simulating a disease of the heart by tying a small thread round the neck sufficiently tight to lessen the force of the circulation in the carotids; and one youth is particularly mentioned, who caused a violent palpitation of his heart by tying a narrow ligature very tightly round the upper part of both of his arms.

Muscles employed to compress arteries.

The effect of muscular contractions in compressing arteries, and thus increasing the action of the heart by impeding the circulation of the blood through them, may be demonstrated by experiment, as well as by an examination of various phenomena.

Proved by experiment.

If the radial artery of a person who is powerfully contracting the muscles of the hand and arm be examined, its pulsations are soon found to become feeble, and at last they are scarcely perceptible; whilst the moment the muscles are relaxed the artery is perceived to beat with its natural force. By the same experiment it may also be shown that the effect of impeding the transit of the blood in the arteries is to increase the action of the heart; for it will be found that, in proportion as the strength of the pulsations of the radial artery diminishes, so is the impulse of the heart increased.

Position of arteries in relation to muscles.

Next let us consider the position of arteries in their relation to the muscles, and learn the mechanism which enables the muscles, on contracting, to compress the contiguous vessels in such a manner as to *impede* the systemic circulation.

For performing this important function, and which I have denominated the *musculo-cardiac* function, we perceive several simple and beautiful contrivances; whilst we also find a striking illustration of this peculiar office of the muscular system in the mechanism which nature has adopted in order to *prevent* the compression of some arteries, when such compression would be injurious to the performance of the functions of those organs which such arteries supply. For, although it appears it is not requisite that every organ should be at all times supplied with the same quantity of blood, yet there are others wherein any deficiency in the supply would be prejudicial, or even fatal, to the functions of life; and hence, whenever the heart requires an additional quantity of blood, that office is fulfilled by impeding the flow of the arterial blood only through the vessels of those organs which do not at all times require a uniform supply of the vital fluid.

Some arteries exposed to, and some protected from, pressure.

In accordance with these positions, we find that the arteries of all organs of the first denomination are so placed, that they must inevitably be more or less compressed by the contractions of the adjacent muscles; whilst the arteries of the other class of organs are so situated, that they are protected from all pressure which would arise from the contractions of those muscles that are contiguous to them.

For a demonstration of the first of these conditions we must look at the arteries of the limbs; for those of the brain, heart, stomach, and iris each exemplify particular contrivances, by means of which the quantity of blood in these organs is *not* subject to any variations from muscular contractions.

Why veins accompany some arteries only.

There are, indeed, several points in the anatomy both of the muscles and of the arteries which seem to be specially subservient to the *musculo-cardiac* function. Arteries are found to accompany the veins where it is intended that *both* these systems of vessels shall be influenced at the same time by muscular contractions; yet, long as this relative position of the blood-vessels and muscles of the limbs has been known to anatomists, no rational explanation of the purpose of this arrangement has ever been given. It is, however, evident, according to the preceding views, that, by such a disposition of the two systems of vessels, the velocity of the blood is equally influenced in the arteries and in the veins whenever the adjacent muscles are contracted; and that, whilst muscular contractions assist in propelling the blood in the veins forwards to the right heart, the valves preventing its regurgitation, we are entitled to infer that the same pressure must impede the current in the adjacent arteries, and thus diminishes the exit of blood from the left heart.

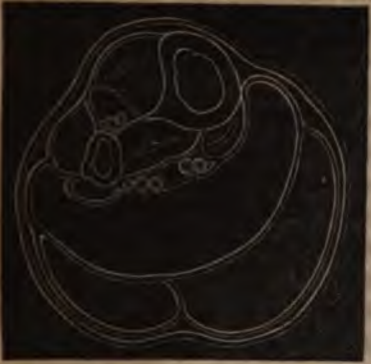
Here, then, we have an anatomical fact affording additional proof of the simplicity and infinite wisdom which Nature displays in all her works, by employing one organ to perform at the same time more than one function: veins and arteries accompanying each other in those situations where it is intended that the circulation both of the venous and arterial bloods shall be influenced by the contractions of the adjacent muscles, and at the same time those vessels which are *not* liable to compression from muscular contractions, not being similarly disposed, either with relation to the muscles or to each other; and hence in the internal viscera, as the brain, lungs, and liver, the veins do not accompany the arteries.

No arrangement could be better adapted for such compression than the course which is assigned to the femoral and brachial arteries, these, enclosed in a sheath, with their *venæ comites*, being in some places completely encircled and embedded in the large muscles of the extremities, so that on every movement of the limbs they must suffer more or less compression.

as those of the extremities.

To exhibit this relative position of the arteries and muscles, we have only to examine a vertical section of the thigh about its middle. The arteries, with the *venæ comites*, are seen enclosed in their sheaths and surrounded by the muscles in such a manner that, when the limb is moved and, consequently, these muscles contracted, their pressure on the arteries must necessarily impede the passage of the blood.

Fig. 5.



Influence of the involuntary muscles on the circulation.

The effects that have been described of the contractions of the muscles of the extremities in compressing the brachial and femoral arteries will suffice to point out all that is here requisite to be noticed as regards the influence of the voluntary muscles in increasing the vigour of the heart; but it will also be found that the *involuntary* muscles perform an equally important share in modifying the circulation of the blood.

I have already shown that the arteries which supply the heart, and likewise those of the stomach, lips, and iris, are each so situated, that the circulation in them can never be interrupted by the movements of these organs. Neither are the arteries of the brain nor those of the lungs subject to pressure from the contractions of any of the voluntary or of the involuntary muscles, the anastomosis and the protection which is afforded to the cerebral arteries warding off the influence of any movements of the neck, and the pulmonary vessels being affected only indirectly by the motions of the parietes of the chest.

Influence of the peristaltic motion of the alimentary canal.

But, when we examine the alimentary canal, we there find an illustration of the function performed by the contraction of the *involuntary* muscles on the circulation. The vermicular motions of the stomach and intestines during the process of digestion, must doubtless, have a very considerable influence on the circulation of the blood, both in the veins and in the arteries of these organs; and hence, during the peristaltic movements of the alimentary canal, we observe an increase in the impulse of the heart, and an increase in the frequency of the pulse. In this respect, the circulation of the blood in the intestinal canal in part resembles that which exists in *worms*, the almost unceasing movements of these animals being sufficient, as I have before noticed, to circulate their blood, unaided by a heart.

Effects of muscular contractions on the *vasa propria*.

Besides the influence of muscles, during their contractions, in compressing the adjacent arteries, it is quite evident that they must also compress those vessels which are distributed in the muscular substance, the *vasa propria*, and thus diminish the circulation through them; and this circumstance satisfactorily explains an observation made by the older anatomists, that when a muscle is exposed in a living animal, its red colour diminishes in intensity during the contractions, and is again renewed when the muscle is relaxed.

How some arteries are protected from muscular compression:

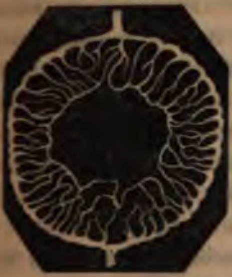
Whilst investigating the phenomena of the *musculo-cardiac* function, it is interesting to examine Nature's contrivances, in order to *impede* the flow of blood through the arteries, when she requires to increase the quantity of the vital fluid in the heart; and it is no less instructive to observe the means which are employed to prevent muscles from compressing the arteries and veins of certain organs, any interruption in the supply of blood to which would be injurious.

by anastomosis.

In those arrangements where such compression from the contractions of muscles is to be avoided, we either find circles of *anastomosis* established between different arterial trunks, or the vessels are so placed that they are completely *protected* from all that pressure to which they would otherwise be exposed by the contractions of the adjacent muscles.

Of the first of these provisions we have examples, besides the anastomosis of the arteries of the heart, in the coronary arteries of the stomach, the intestinal canal, the eyelids, and lips, and in the circles of anastomosis of the arteries of the iris; the effect of all which free inosculations is obviously to render any obstruction in the arterial circulation in these organs impossible; a circumstance which would be constantly taking place from their unceasing movements, had not such anastomosis been established.

Fig. 6.



The two ciliary arteries may be seen in the diagram, each dividing into two branches, which afterwards reunite, encircling the interior of the globe of the eye. From this arterial circle innumerable branches go off at right angles and are distributed upon the iris; and all these branches again anastomose with one another and form a circle round the pupillary opening. Thus, notwithstanding the varied and constant movements of the iris, every part of it must be uninterruptedly supplied with blood.

Coronary arteries of the heart.

The other provision, or where certain arteries are protected from any compression from the contractions of the adjacent muscles, is exemplified both in the heart and in the brain. In order to prevent any interruption to the circulation in the vessels destined to supply the heart, there is not only a free anastomosis between the coronary arteries, but also a peculiarity of structure to which I have alluded; both arteries and veins passing along a tendinous furrow or groove between the auricles and ventricles in such a manner that, during the unceasing contractions and relaxations of these cavities, the circulation of the blood, neither through the veins nor arteries, can ever be interrupted.

See page 15.

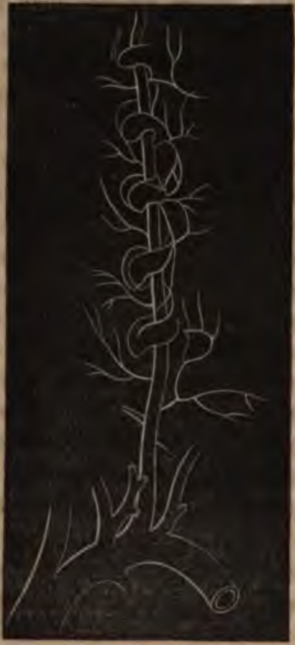
Arteries of the brain.

And again, if we look at the vertebral arteries, we observe that these vessels are also protected from all muscular compression, independently of having a free anastomosis established between them. These arteries pass along bony canals, by which they are so protected, that the current of the blood in them can never, like that in the carotids, be interrupted by any pressure from the contractions of the muscles of the neck during the very frequent and varied positions of the head; whilst the anastomosis established between the carotid and vertebral arteries secures a constant supply of blood in all the arterial ramifications in the brain.

The course of the vertebral arteries.

The diagram represents the right vertebral artery passing along the bony canal formed in the transverse processes of the cervical vertebræ, by which course it is completely protected from all pressure of the muscles of the neck during their contractions.

Fig. 7.



Indeed, if there had not been such a distribution of the arteries of the brain, and if the vertebral arteries, like the carotids, had been constantly exposed to compression from the contractions of the muscles of the neck, and also from alterations in the position of the head, or if there was no free communication between the vertebrals and carotids, then the quantity of arterial blood within the head would have been exposed to constant variations, and the functions of the brain liable to incessant disturbance; accidents which the mechanism I have now described is, however, calculated to avert.

Illustrated in some animals;

In further corroboration of the purposes served in the economy by these peculiarities in the course of some arteries, I may likewise notice the ingenious mechanism which is met with in the vascular system of certain organs of the lower animals, all which are evidently intended to guard them against any compression from the contractions of the adjacent muscles, when such pressure would be injurious.

in the feline tribe;

In those of the *feline* tribe, who use their paws not only for climbing but for grasping their prey, to prevent the pressure which is made unavoidably on the limbs impeding the circulation of the blood in the brachial arteries, each of these vessels passes through a *bony* canal in the humerus, especially formed for that purpose, and at that part of it where the artery would be most liable to compression were it to follow the ordinary course. And in the *lion* there is such a distribution of the arteries of the head, that the muscles of the jaw can be kept for a long time in a state of powerful contraction without the circulation being interrupted; whilst, also, in this ferocious animal, as in others of the feline tribe, the brachial artery passes through a bony canal, so that its circulation cannot be interrupted by the powerful and long-continued muscular contractions of its paws when holding its prey.

In the *bradypus tardigradus;*

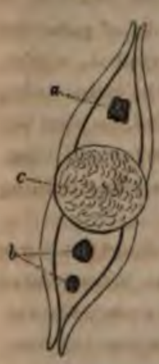
In the tardigrade animals, as the *sloth,* we find that there are no less than two distinct provisions in the arrangement of the brachial arteries, evidently intended to secure the circulation from being interrupted by the long-protracted muscular contractions to which their limbs are exposed when climbing or grasping their prey. Besides that peculiarity of structure in the feline tribe, where the artery is guarded from compression by passing through a notch in the humerus, the brachial artery of the sloth divides into numerous parallel branches, which afterwards reunite into one trunk; so that when this creature is suspending itself on a tree, or grasping its prey, which it often does uninterruptedly even for many hours, the long-continued contraction of the muscles caused by the grasping of the limbs cannot impede the circulation of the blood in the remote branches of the brachial artery. Mr. Langstaff found it difficult to separate the branches composing this brachial plexus; but, from the dissections he made, he was disposed to believe that, besides the artery forming a plexus, the trunk of the artery itself is continued through the plexus, so that, for the common purposes of life, the circulation can go on in the trunk of the vessel.

(See Phil.Tr., 1804.)

In the aorta of fishes;

For a like purpose a peculiarity is found in the course of the aorta in some *fishes.* After having supplied the abdominal viscera, that vessel in the shark passes along a channel formed by the bony processes of the vertebræ, so that the circulation can never be disturbed in the powerfully muscular tail during any of its movements.

Fig. 8.



The diagram represents a section of the tail of the shark, wherein, besides the spinal canal (*a*), there is a foramen (*b*), in the body of the vertebræ (*c*), for the passage of the aorta, and another for the vena cava.—Grant.

In the tails of prehensile monkeys.

The same arrangement is remarkable in the long flexible necks of birds, and in the prehensile tails of monkeys, the continuation of the aorta being in them protected from pressure by the inferior rings of the vertebræ, whilst there are also very numerous inosculations of the arteries of the tail.

Here, then, as well as in the human brain and heart, are examples of arteries passing along a course by which they are completely protected from all muscular pressure; whilst we have found other arteries so placed in relation to muscles that they are subjected to muscular compression in order to fulfil a very important function in the animal economy.

Anatomy of the spina arteries;

Anatomy further reveals a circumstance in the circulation of the *spinal chord* which is equally essential to be borne in mind, whilst prosecuting our pathological investigations on the nervous system, as that which I have already mentioned in the arterial circulation of the brain; though I am not aware that this important structure has ever been noticed by those ingenious physiological inquirers who have of late years bestowed so much assiduity in investigating the functions of the cerebro-spinal system.

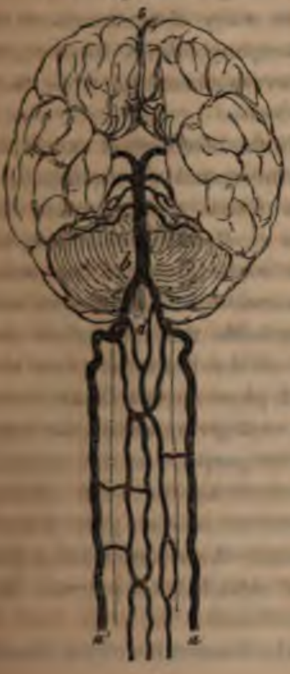
The interesting anatomical fact to which I allude is, that the very same physical arrangement which is resorted to by the economy for securing a regular supply of blood to the brain also fulfils a similar office to the spinal chord; and consequently that the spinal chord, like the brain, must be influenced by disturbances in the action of the heart; and hence, too, will arise another assemblage of *symptoms* in the diseases of the heart, and which I will endeavour to point out are as important an addition to semiology as those derived from the brain itself.

are branches from the vertebrals.

Their anastomosis.

It had been shown, and the parts were accurately delineated by Haller, that the whole prolongation of the spinal chord from its exit through the cranium to its termination in the *cauda equina*, is supplied with blood chiefly by the *spinal* arteries; the spinal arteries coming off from the vertebrals immediately after these vessels enter the *foramen magnum* of the occipital bone. But the spinal chord, it ought to be recollected, like the brain with its carotids as well as with its vertebrals, has, besides the spinal arteries, small anastomosing branches from the parent trunk, from the intercostal, from the sacral, and from the lumbar vessels; so that any interruption to the circulation in the spinal arteries may be compensated for by a supply of blood from these other channels.

Fig. 9.



This peculiarity in the arrangement of the arteries of the cerebro-spinal system is illustrated by the accompanying figure. The two vertebral arteries (*a*, *a*) ascend parallel to the spinal chord, which is represented in dotted lines, pass over the cerebellum, and inosculating with each other at (*b*), where they form the basilar artery. A little anterior to the union of the vertebral arteries two branches (*c*, *c*) and (*d*) come off from each trunk, which form the anterior and posterior spinal arteries.

Cerebro-spinal system supplied with blood from one channel.

The spinal chord, like the brain, is therefore supplied with blood almost entirely by arteries, the circulation through which can never be interrupted from any movement of the adjacent muscles; whilst at the same time, like the brain, it must be readily influenced by every disorder in the action of the heart.

Physiological inferences.

The circumstance of the whole *cerebro-spinal* system being supplied with blood from the same channels, so that the circulation shall be always modified in both of the great nervous centres at the same moment, and whenever there is any change in the action of the heart, is a fact highly important to physiology, and will materially assist in explaining the intricate association in the functions of these two subdivisions of the nervous system; whilst it will also elucidate many interesting pathological phenomena. Thus, too, we have obtained an additional proof of the unity of the brain and spinal chord, as one great nervous system; and we can now explain how, in many disturbances of the heart, such as those which accompany febrile diseases, the two nervous centres with the nerves emanating from them are so often simultaneously affected.

Although these peculiarities in the distribution and in the course of the arteries of the cerebro-spinal system have been long known, yet the purposes which they serve in the economy have certainly not been at all understood; nor, indeed, could they have ever been conjectured, far less satisfactorily explained, until the *musculo-cardiac* function was demonstrated. And it is remarkable that ever since the peculiar course of the arteries of the brain was first described, up to the present period, physiologists should have, one after another, been satisfied with giving nearly the same unphilosophical explanations of the purposes of this singular vascular distribution; some conceiving that the osseous canals through which the vertebral arteries pass merely serve the purpose of a defence, and others conjecturing that this peculiar arrangement was intended to prevent any undue increase in the size of the vessels.

Besides these peculiarities in the distribution of the vessels of the brain and spinal chord, all which are intended for securing to those organs a regular supply of the vital fluid, it is also of importance to notice the proportionably large quantity of the mass of the blood which goes to the cerebral system, as this will assist in explaining how that system should be affected, more than any other, when the functions of the heart are disturbed.

Brain supplied with a large proportion of blood.

For, if Haller's calculation be correct, or if it be even an approximation to the truth, that the weight of the brain is about seven pounds in a body weighing two hundred pounds, and that one-sixth of the whole mass of blood goes to the brain, then the brain must be supplied with nearly five times more blood than any of the other parts of the body.

Haller's calculation.

Having said thus much on the anatomy of the vertebral arteries, and adverted to the unsatisfactory opinions that have been offered of the purposes of their peculiar course and mode of distribution, it may be fit, also, to draw the attention of the reader to some peculiarities in the *carotid* arteries; for it must appear strange that, if such decided means were required in order to ensure an uninterrupted circulation in the vertebral, that the carotid arteries should be so much exposed to external injury, and their circulation to so many interruptions from the contractions of the muscles of the neck.

Anatomy of the carotid arteries.

It seems, however, that the same protection to the circulation, so requisite for the vertebrals, is not wanted in the carotids, although a larger proportion of the blood which goes to the brain is supplied by the internal carotid arteries. The external carotid is distributed upon the neck, the face, and the external coverings of the brain; but the internal carotid conveys to the brain a large tributary stream of the vital fluid; but of so little importance is the supply of blood by the carotids to that of the vertebrals, in animals, that, when a ligature is placed on one of these vessels, no particular symptoms supervene; and even "when both carotids have been tied the animal neither died nor appeared to be very uneasy." Whereas, when the vertebral

Haller.

arteries of rabbits are compressed, it is followed by instant death.

Astley Cooper.

Before concluding these remarks on the peculiarities in the arteries of the brain, and which I have deemed it essential to bring together in conducting our inquiries on the pathology of the heart, there are likewise some peculiarities in the structure of these vessels, and in their mode of distribution after they have entered the cranium, which are here worthy of notice.

Cerebral arteries—structure of.

"All the branches of the cerebral arteries contained within the skull have a thin, solid, and more brittle substance than the other arteries of the body;" and as the size of these vessels cannot be much diminished, from the incompressible nature of the cerebral pulp, they do not require to possess those powers of dilatation and contraction like the arteries of the external and soft organs.

Haller.

Comparative anatomy assists us in this, as in most other physiological inquiries; and it appears that, throughout the different races of organized beings, the magnitude of these two sets of vessels—the carotids and the vertebrals—always has a certain ratio with the brain of the class of animals to which they belong. In proportion, therefore, as the anterior or intellectual part of the cerebrum is small, so we find the size of the carotids diminish; and, on the other hand, as the anterior portion increases, so the carotids become large.

Ratio of the comparative size of the carotid and vertebral arteries in animals.

And "it has been made a general remark," observes Bichat, "that animals with long necks, in whom the brain is necessarily far from the heart, the heart cannot excite the brain so vigorously; their intelligence is more limited, consequently the cerebral functions are more narrowed. On the contrary, those animals who have short necks, and consequently in whom the brain and heart more closely approach, commonly have a corresponding mental energy. Mankind, who have the head placed far above the shoulders, compared with those in whom it is very close, sometimes offer the same phenomena."

Effects of long necks.

"A Roman Emperor, to show the certainty of his hand, did shoot a great forked arrow at an ostrich as she ran swiftly upon the stage, and struck off her head; and yet she continued to race a little way with the head off."

Bacon.

Each vessel, when disturbed, causes different symptoms.

Further, as each of the cerebral vessels supplies different portions of the brain—the internal carotids conveying the blood to the anterior, and the vertebral arteries supplying chiefly the posterior lobes, the cerebellum, and the spinal chord—it may be anticipated that, whenever the circulation in any one of these vessels, or pairs of vessels, is disturbed, different symptoms will be manifested, according to the portion of the brain which is supplied by the particular artery.

Arteries of the membranes of the brain and spinal chord.

When inquiring into the peculiarities of the arterial circulation in the cerebro-spinal system, we should not omit noticing those of the *membranes* by which it is surrounded, as their vascular connections must have a considerable influence on some pathological phenomena.

Now, we find that the same provisions which are employed to secure a due proportion of blood to the brain are also found in the *dura mater*, that membrane being supplied with branches from both the external and the internal carotids, and also from the vertebral arteries. And in a similar manner the coverings of the spinal chord are supplied with blood as the chord itself, branches from the spinal arteries, and from the intercostal, lumbar, and sacral arteries, being all ramified on these membranes.

Peculiarities in the structures.

The fact that the *fibro-cartilaginous* matter is altogether wanting in the cerebral arteries serves to illustrate some of the pathological characters of these vessels, and how they are influenced in so remarkable a manner when the functions of the heart are disturbed. This peculiarity in the cerebral arteries is, that they are reduced to capillaries before they enter the cerebral pulp; and John Hunter was of opinion that they do not anastomose in the substance of the brain—a very probable circumstance, as it points out the use of anastomosis in other organs of the body, and that such a vascular distribution could not be required within the bony cranium.

cerebral ar
[illegible]
anastomose

Pathological inferences.

From the very peculiar arrangements and distribution of the vertebral arteries which have been pointed out, it appears to me legitimate to conclude that, inasmuch as means are employed by the economy to provide the brain and spinal chord, in the healthy condition of the body, with a uniform supply of blood, so it must happen that, when the regularity of the heart's functions are disturbed, the nervous system will suffer more than any of those for the due performance of whose functions such regular supply of the vital fluid is not necessary, and hence it is that many of those disorders which are so frequently supposed to commence in the head are, in fact, caused by a disordered heart. On such grounds I shall hereafter endeavour to account for the unnatural sounds, false images, vertigo, inability to balance the body, and various disturbances in the functions of the cerebro-spinal system, which so frequently, nay, almost invariably, accompany diseases of the heart; and all these changes which take place in the functions of the nervous system from a disturbed circulation, become useful diagnostic symptoms in diseases of the heart, as well as serve to establish a rational system of treatment.

Tortuosities of the internal carotids.

Besides the explanation I have now offered of the important use which is derived from bony canals for the passage of the vertebral arteries, I also apprehend that a very different purpose, than what has been hitherto conjectured, is served by the *tortuosities* of these vessels, as well as by the tortuous course of the internal carotid arteries before they enter the cranium.

See page 35.

Erroneous notions of their use.

That such tortuosities in both these vessels can materially alter the velocity of the current of the systemic blood before it enters the brain, as has been usually supposed to be the effect of their serpentine course, is not the case; for it is clearly demonstrable, that even very considerable bendings in a tube cause so little diminution in the velocity of the current of a fluid passing through the tube, that such a diminution is scarcely calculable, and is not even taken into account by practical engineers. Any such explanation of the use of the serpentine course of the cerebral arteries is, therefore, quite untenable, and we must look for some less objectionable explanation of this peculiar vascular arrangement.

Explanation of the author.

To me it appears that the tortuous course in the arteries of the brain is solely intended to prevent the additional pressure which would be caused upon the brain by the weight of the column of blood, when the head is bent downwards, were these vessels perfectly straight. I have already noticed that in some of the lower animals, whose habits require the head to be kept for a long time in a depending position, still further means, besides a serpentine course of the vessels, are resorted to for performing a similar office in the circulation. In the graminivorous tribe I have mentioned that we find the carotid arteries form a *plexus*, dividing into numerous branches, which afterwards reunite; and in diving birds, whose heads are often placed downwards when the animal is in search of food, there is a vascular plexus in the ophthalmic artery which, as in the graminivorous animals, will counteract the additional pressure of the column of blood on the eye, which would necessarily be produced from that attitude of the head.

This is, no doubt, the chief function which is derived from the tortuosities of the internal carotids, although a further use, an additional purpose, I am inclined to believe, is obtained from the curvatures in the vertebral arteries.

Additional use of curvatures.

In their passage along the vertebral canals, until they reach the second cervical vertebra, these vessels cannot be influenced by any movement of the spinal column, for there is no degree of rotatory motion in the lower cervical vertebræ, but merely a slight gliding or sliding motion obliquely backwards or forwards. When, however, the vertebral arteries reach the second cervical vertebra, and make two turns before entering the *foramen magnum*, these turns are so directed, that whatever movements are made by the head on the first vertebra, or by the first and second vertebræ on one another, the arteries, from their bendings, can never be injured by such movements, nor can the passage of the blood through them be at all interrupted.

There is another peculiarity in the internal carotid arteries, besides their tortuosities, worthy of notice here, and which, as physiological science advances, may explain some pathological phenomena which we do not yet comprehend. No sooner have these vessels entered the osseous foramina, destined for their passage, and penetrated into the cavity of the skull, than they ascend to the *sella turcica,* "where they are naked and bathed in the blood of the cavernous sinus." What purpose this serves in the economy has never been even conjectured, though it be impossible to doubt that this singular arrangement performs some important office.

Carotids bathed in the blood of the cavernous sinus.

And the circumstance of a small branch of the sixth pair of nerves, which commences the great sympathetic nerve, being also bathed in the blood of the sinus, renders this structure still more remarkable.

Veins of the cerebro-spinal system.

The *veins* of the brain and spinal chord exhibit peculiarities in their structure and arrangements no less remarkable, and of no less pathological importance, than those of the arteries; and the symptoms in disorders of the heart, which are manifested by changes in the venous circulation of the nervous system, form a class of no inconsiderable value.

Whilst various contrivances are employed to secure the cerebro-spinal system having at all times a due quantity of arterial blood, there are means equally ingenious in the venous system for the purpose of securing a free transit of the venous blood, and thus ward off the evil effects of an over-distention in the sanguiferous system of the brain and spinal chord.

The number of the veins of the brain and spinal chord is infinitely greater than of the arteries. They have innumerable anastomoses; and, like the veins of the lungs, liver, and kidneys, they have no valves; neither do they accompany the arteries, nor have their great trunks the common structure of other veins. The firm unyielding walls of the sinuses, and the vast number of veins which modern anatomists have discovered embedded in the *diploe* of the cranium and bones of the vertebral column, are all striking peculiarities in the character of the veins of the nervous system.

All these peculiarities in the structure and arrangement of the venous system of the brain and spinal chord must, undoubtedly, have some adequate offices to perform in the circulation. The great number of the veins, the freedom with which they anastomose, the unyielding walls of the sinuses, and their passage through the middle of the bones, must afford ample means for the blood, under all circumstances, to escape from the head; and, as was observed by Haller, "no violent symptoms follow upon tying a vein, however large, or even both the jugular veins." Hence it may be remarked, that whilst, on the one hand, the most ample means are taken to secure the cerebro-spinal system being supplied with a due quantity of arterial blood, on the other hand an extraordinary facility is afforded to the return of the venous blood.

Besides these peculiarities in the structure and arrangement of the cerebral arteries and veins, the prolongations of the *dura mater* ought likewise to be taken into consideration. These prolongations are calculated to prevent one portion of the brain pressing upon the other in the various positions of the body, and from compressing one another when the brain happens to receive any concussion; and to avert such accidents we find that in the swiftest quadrupeds the cerebrum and cerebellum are separated from each other by a bony partition. This arrangement of the subdivisions of the brain seems to be intended for a similar purpose as that which we find in the testis, the delicate structure of that gland being subdivided by processes of the *tunica albugenia*, by which the different lobules are prevented from pressing on one another in the varied positions of that organ.

Monro—Kellie.

Though it may have been satisfactorily shown that the cerebral pulp itself cannot be compressed, it must not, however, be concluded, as some physiologists have done, that the aggregate contents of the cranium must always be the same. However small may be the degree of that incompressibility, the phenomena of disease seem to prove indisputably that changes in the quantity of the contents of the cranium do constantly take place, nothwithstanding the incompressibility of the cerebral pulp. The communication of the bony cranium externally, by the *foramen magnum* of the occipital bone, as well as by the lesser foramina through which vessels pass, must permit the blood which is contained in them to be altered by the atmospheric pressure; and, although such compression must be very limited, still a slight change is, we know, quite sufficient to influence the brain, of which many illustrations are seen in diseases and in wounds and injuries of the head.

See page 45.

The arrangements to which I have alluded in the cerebral arteries of some animals, where these vessels are formed into a *plexus* in order to prevent the pressure of the superincumbent column of blood upon the brain when their heads are placed downwards, afford a negative but no less convincing proof of the compressibility of the contents of the cranium; for, were these incompressible, such a vascular distribution could not have been required.

Ganglionic system—its circulation.

I need say little as regards the circulation of the *ganglionic* system, for, however complete that system may of itself be as regards the disposition of its nerves, yet, as those nerves which form it are all connected with the *cerebro-spinal* system, they will be influenced by all those modifications in the circulation which influence the brain and spinal chord. So that we are led to the important conclusion that the circulation of the blood in the great nervous centres is in all of them regulated and modified by the same causes.

Recapitulation.

Reviewing all these peculiarities in the circulation of the blood in the *cerebro-spinal* system, there are several points in the anatomy to which I have alluded that may be briefly recapitulated; these being equally interesting to the physiologist as they are important in affording a satisfactory explanation of many of the symptoms in diseases of the heart, and of the cause of many disorders of the nervous system.

1st. We have seen that the brain and spinal chord are supplied with a larger quantity of blood than any other part of the body of an equal bulk.

2ndly. That the cerebro-spinal system is supplied with blood by the internal carotid and vertebral arteries, but the two carotids, being larger in their calibre than the vertebrals, supply the greatest proportion of the blood.

3rdly. That the circulation of the blood in the vertebrals is much less liable to interruption than in the carotids, special means being resorted to for securing the free passage of the blood from the heart to the brain, by osseous canals for the course of the vertebral arteries.

4thly. That, as both the brain and spinal chord are supplied with blood by the same channels, the whole nervous system may be simultaneously influenced by changes in the action of the heart.

5thly. That a regular and equal circulation in the nervous centres is secured, not only by a free inosculation between the internal carotid and vertebral arteries, but also by the trunks of the two vertebral arteries joining together on entering the cranium, and afterwards subdividing; by which the circulation in all the cerebral branches of each of these vessels must be rendered uniform.

6thly. That the brain and spinal chord are not only supplied with the blood both of the vertebral and internal carotid arteries, but these vessels freely anastomose with the arteries of the external parts of the head and trunk, which anastomosis further secures a regular supply of blood to the whole cerebro-spinal system.

7thly. That the veins of the brain and spinal chord, like the arteries, are so placed and constructed that no external causes can prevent them from duly performing their functions; and they are always able to receive any superabundant blood, and fulfil this office without causing any pressure on the cerebral pulp.

8thly. That the two spinal arteries are formed by branches from each vertebral trunk, thus securing the regular and equal distribution of the blood in the spinal chord.

9thly. That the tortuous course, both of the vertebral and internal carotid arteries, before entering the head, prevents any disturbance of the circulation when the head is in a depending position, by taking off the weight of the superincumbent column of the blood.

10thly, and lastly. That, as the different portions of the brain and spinal chord are supplied each by branches of different trunks, the symptoms which accompany diseases of the heart will differ according as the circulation is changed in one or other of the cerebral arteries.

Phenomena depending upon the Musculo-cardiac Function.

The musculo-cardiac function explains various phenomena;

I shall now proceed to show that the *musculo-cardiac* function enables us to account for many important phenomena which are constantly taking place in the living body, and which could never have been explained until a knowledge of this function of the muscles had been discovered.

Some muscular movement will be observed to precede every effort which is made to increase the vigour of particular organs, because, for such a purpose, it is first required that the vigour of the heart itself shall be increased. We, therefore, find that, unless when the body is in a state of perfect tranquillity, which can scarcely ever happen but during sleep, the circulation of the blood in the different organs is constantly varying, as any muscular movement, however slight, increases the influx of the venous blood, and at the same time impedes the exit of the arterial blood from the heart. Thus, in some organs, the quantity of blood is diminished, and in others increased, by every motion of the body, those which are called upon to perform particular functions receiving an increase, whilst other organs, whose office is less urgent, experience a diminution, in the supply of the vital fluid.

It is, indeed, interesting to contemplate the contrivances which are employed in order to fulfil this office in the various organs, and to observe the injurious effects which result from deviations in the due execution of this function of the circulating apparatus.

those on awaking from sleep.

No more satisfactory illustration need be given of the office of the muscles in modifying the circulation of the blood, or of the *musculo-cardiac* function, than by glancing over the development of those phenomena, and by reviewing the various functions successively as they are evolved, which may be observed in a person at the moment of waking from sleep, and when passing from sleep to wakefulness.

The first indication of a person passing from sleep to waking is some movement of the body. The posture in which he had reclined is changed; and almost at the same moment, and just when becoming conscious of existence, the muscles of the extremities are thrown into contraction; the limbs are stretched; he yawns, and, finally, the intellectual powers awake.

These phenomena, which precede both sleep and wakefulness, are so uniform, and are so universal throughout the animal creation, that it would be unphilosophical to suppose that they were not a link of some chain which, though hitherto inexplicable, could not be reasonably conceived to be the result of chance or the effect of habit.

Phenomena accompanying sleep—how explained.

All these muscular movements can, indeed, be satisfactorily explained by contemplating the effects on the circulation, which, as I have endeavoured to demonstrate, are produced by muscular contractions on the adjacent arteries.

See Appendix (U).

The almost instantaneous effect of a person stretching the limbs whilst awaking from slumber is that of rousing the powers of the mind, and this is caused from an accumulation of blood in the heart, which such motions necessarily create, and which, by increasing its vigour, enables it to propel an additional quantity of blood to the head.

Scarcely has a man awoke, and the brain received this additional quantity of the systemic blood, ere the mental powers are resuscitated, and, having been refreshed by "balmy sleep," they almost immediately resume their wonted vigour.

The powers of the mind having revived, man is now befitted for his varied avocations, in the execution of which the *musculo-cardiac* function continues to perform an important share.

Phenomena which precede sleep.

The phenomena to be observed before falling asleep form a striking contrast to those which take place when awaking from slumber, and these afford at least a negative proof of the influence of the *musculo-cardiac* function.

On the approach of sleep, in place of making any muscular movement, we prepare ourselves by seeking that posture which will relax the greatest possible number of the active organs of motion. We recline in the horizontal posture, and place the limbs in a state of semi-flexion,—these preparations having the effect of tranquillising the circulation, and of equalising the supply of blood to every part of the body, so that the vigour of all is diminished, and no organ is more excited than another.

The habits and avocations of man afford ample illustrations of the large share which the *musculo-cardiac* function contributes in carrying on the circulation of the blood.

Phenomena which precede exertions explained;

Observe how the strength and vigour of the body are increased when we require to make any great exertion, and how accurately this office of the muscles has been described by the immortal poet :—

> "Stiffen the sinews ; summon up the blood ;
> Now set the teeth, and stretch the nostrils wide ;
> Hold hard the breath, and bend up every spirit
> To his full height."—SHAKSPEAR.

In order to produce a temporary increase in the heart's action, I have already remarked that it is requisite to give to that organ an additional stimulus ; and this is at once effected by contracting such muscles as will compress the contiguous arteries, and thus impede the transit of their blood.

those made before running or leaping;

If, by way of illustration, a man be about to make any great exertion, such as running or leaping, he prepares himself, as it were, by first vigorously contracting the muscles of the arms and clenching his hands.

preparing to endure pain;

For the same reason, when a person is subjected to pain, as that of a surgical operation, he prepares himself to endure it by throwing into action almost all the voluntary muscles, grasping firmly with his hands, and pressing his feet against some resisting body. And when the woman, during parturi-

and during parturition;

tion, is about to make a powerful expulsive effort to assist the uterus in giving birth to the infant, she in like manner throws into violent and long-continued contractions the muscles of the extremities, clenches the jaws, and squeezes, with a convulsive effort, whatever may be within her reach.

"A man leapeth better with weights in his hands than without. The cause is for that the weight, if it be proportionable, strengtheneth the sinews by contracting them. Otherwise, when no contraction is necessary, the weight hindereth. As we see in race-horses, men are curious to foresee that there be not the least weight upon the one horse more than upon the other."—BACON.

and in disease;

Muscular exertions are also employed to effect a similar purpose in those who, from disease in the urinary passages or rectum, have great difficulty in voiding their contents; so that, before endeavouring to accomplish such evacuations, they forcibly contract some of the voluntary muscles,—muscles whose actions are totally unconnected with those which are employed to perform the evacuations.

and in recovering from syncope.

No less remarkable is the influence of the *musculo-cardiac* function on those who are recovering from a state of *syncope*. Having passed into a condition where the last spark of life had been apparently extinguished, the first symptoms of recovery from fainting are ushered in by a series of convulsive movements of the voluntary muscles. Long-protracted inspirations are succeeded by powerful expirations, the limbs are convulsed, and soon afterwards the intellectual powers are resuscitated.

The effects of bodily exercises explained.

The influence of muscular contractions in increasing the vigour of the heart explains, in a very satisfactory manner, the salutary effects which children derive from their almost constant movements, and from the benefit of all kinds of bodily exercise. How, for instance, a person, when he feels sluggish and inert after mental fatigue, or from want of sufficient bodily exercise, is revived and invigorated by *walking*. It also accounts for the exhilarating influence of *driving* rapidly in a carriage, and fully explains the intoxicating

Walking, driving, and riding;

effects which, according to the poet, are experienced while galloping across the boundless Desert. (a)

dancing;

And no less remarkable are the exhilarating effects of *dancing*,—so much so, that it has even been said to cure the bite of the tarantula. At a large manufactory, where many children were employed, the best of effects resulted from making them begin the day of toil and labour with a cheerful dance. The dance, indeed, seems to be common to mankind in all stages of civilization, and its exhilarating influence universally acknowledged, not only by the young and the gay, but sometimes even by those far advanced in life.

of gestures in public speaking.

On the orator this influence of muscular movements is no less striking. His gestures keep pace with his mental excitement, and his gesticulations become more and more extravagant in proportion as he becomes impassioned; the heart thus acquiring an increase in the quantity of its blood, and, consequently, the brain receiving a proportionately increased supply of the vital fluid.

See Appendix (H).

All these phenomena can be explained now that we comprehend how muscles, by their contractions, increase the quantity of arterial blood in the heart; and it is only surprising that physiologists, when endeavouring to account for the beneficial influence of various exercises, whilst they were aware that they increased the return of the *venous* blood to the central organ of the circulation, should not have advanced a step further, and considered what must be the effect of the contractions of muscles on the *arteries* adjacent to them.

Influence of the musculo-cardiac function in diseases;

My attention was directed to some of these phenomena, and to the physical explanation of them which I have now given, when attending a person who had frequent attacks of gout, and who had been some time before affected with an arthritic inflammation of the pericardium. After that illness he suffered from palpitations of the heart every morning, just at the moment when he awoke, but they continued only a few minutes. He also stated that he was in the habit of *yawning* and stretching his limbs, which he always did whilst in the act of awaking, and immediately afterwards he felt the palpitation. He further observed, when interrogated on this point, that, if he accidentally awoke during the night, and stretched himself, palpitation of the heart always ensued. of yawning;

(a) "A young French renegade confessed to Chateaubriand that he never found himself alone galloping in the desert without a sensation approaching to rapture which was inconceivable."—BYRON.

The effect of yawning and stretching the body in disturbing a diseased heart I also observed in a person who had for many years suffered from a disordered circulation, and who was recovering from a febrile illness, for the relief of which an antiphlogistic treatment had been pursued. When convalescent he had no uneasy feelings remaining except a pain in the head, which came on every morning immediately after he awoke, but which did not continue longer than about ten minutes. From the circumstance of this headache occurring only after he awoke, and from his stating that he was in the habit of yawning and forcibly stretching his limbs whilst he was awaking, it appeared to me probable that the increase of blood in the irritable heart, caused by those movements, produced the headache in the same manner as it had in the former instance caused palpitation.

in chorea; The effects of the unceasing muscular movements in *chorea* also afford evidence of the *musculo-cardiac* function. In a young woman who was severely afflicted with chorea the heart's beats were so frequent during wakefulness, that I found it quite impossible to count them; but when she was asleep, and had no involuntary action of the muscles, the pulse did not exceed eighty beats in a minute.

in tetanus; What the effects of *tetanus* may be on the circulation I have had no opportunities of ascertaining; but, from the decided benefit that has in some instances been derived from blood-letting, there is good reason to suppose that the permanent contraction of the muscles, characteristic of that disease, must, by impeding the circulation in the arteries, cause more or less congestion in the organs of circulation.

The influence of the *musculo-cardiac* function explains how in different postures of the body.

there is such a remarkable difference in the number, as well as in the strength, of the heart's pulsations, according as the body happens to be in the recumbent or in the erect posture, —a difference particularly striking in all invalids, and which must have led to the common advice of the well-known good effects of preserving a supine posture in the treatment of diseases. The difference in the pulse is, indeed, sometimes so considerable in the different positions of the body, that it is necessary, before being able to form a perfectly correct judgment of the state of the circulating system, to examine both the heart and the arterial pulse when the patient is in the recumbent, as well as when he is in the erect, posture.

Many symptoms of diseases explained,

If, therefore, the influence of muscular contractions on the *arterial* circulation be established, it not only enables us to give a rational explanation of many phenomena which take place in the healthy state of the body, but it opens a most important field for pathological research. It explains the hurtful effects of severe bodily exertions in over-exciting the heart; it explains, also, the beneficial influence of bodily tranquillity in all those ailments wherein the circulation is hurried or disturbed; and it accounts for the great frequency of some diseases of the heart in two very opposite classes of persons,—in those whose avocations expose them to violent muscular efforts, and in those whose organs of circulation, in consequence of not taking much bodily exercise, obtain little or no assistance from the *musculo-cardiac* function.

and their frequency in particular classes of individuals;

The various involuntary movements which occur in some diseases, such as those during convulsive, epileptic, and hysterical fits, the permanent muscular contractions in those afflicted with trismus, and the temporary movements in chorea, must all have a greater or less influence on the action of the heart, and, as I have already said, can only be explained by a reference to the *musculo-cardiac* function.

and the difference in the vascular system in the two sexes.

In like manner we can account for those differences so remarkable in the vascular system of the two sexes. As the circulation of the blood in woman, from her inactive habits, derives little assistance from muscular contractions, the arteries become more lax and capacious than those in man;

whilst the veins of men are proportionably much larger than those of women, the venous circulation being greatly influenced by all those muscular exertions to which men are so much exposed; and, in proof of these differences in the vascular system of the two sexes, it is only necessary to compare the distended and tortuous veins of the arms of an artisan with the delicacy and beauty of the cutaneous surface of a woman.

CHAPTER III.

THE RESPIRATORY ORGANS.

Reciprocal influence of the respiratory organs and heart; influence of inspiration and expiration; uses of their various modifications; heart's action changed by them; remarkable examples of; the pulmo-cardiac function; this function demonstrated; utility of the function; its influence on respiration; the veno-pulmonary function; this function demonstrated; pulmo-cardiac congestion explained; its pernicious effects; training explained; pernicious effects of too full inspirations; various illustrations of phenomena connected with the respiratory and circulating organs; certain instinctive acts of the economy explained; laughter, crying, weeping, sobbing, and sighing; vomiting, hiccup, sneezing, and coughing; their effects on the circulation; sea-sickness explained; modes of relieving it; diving explained; effect of swinging on the circulation; how the balance of the circulation is preserved in different postures of the body; this illustrated in the circulating organs of animals; subject concluded.

HAVING noticed the power of the heart in propelling the blood,—the different modes by which the arteries regulate its distribution to the various organs,—the changes produced in the circulation by the action of the capillaries and the veins,—and having also pointed out how the supply of blood, both to the right and left heart, is modified by the *musculo-cardiac* function,—we come next to consider the influence which the respiratory organs exercise on the function of the heart, and the share which they have in carrying on the great function of the circulation of the blood.

Influence of inspiration on the circulation.

By whatever powers the venous blood reaches the two venæ cavæ, *inspiration*, or that movement which draws the air into the chest, assists in bringing the *venous* blood into the right heart. Inspiration also assists the circulation of the blood in the pulmonary arteries, the expansion of the lungs facilitating the ingress of the venous blood into the pulmonary arteries, and also permitting the arterialised blood to flow readily through the pulmonary veins.

Influence of expiration.

Whilst the entrance both of the air and of the venous blood into the chest takes place during inspiration, so, in like manner, is the air expelled and an additional impulse given to the stream of the arterial blood during *expiration.* The diminution in the capacity of the lungs and the subsidence of the parietes of the chest and abdomen, which take place during expiration, aid by their pressure the transmission of the arterialised blood from the lungs into the left heart, and also assist in propelling the blood from the left heart along the large arteries; whilst at the same time they impede the current of blood coming from the right ventricle into the pulmonary artery. Inspiration may be therefore considered as accessory to the *venous,* and expiration to the *arterial,* circulation, the one aiding the heart like a sucking, and the other like a forcing, pump.

Haller's Physiology.

Reciprocal influence of respiration and circulation.

Hence, too, the reciprocal influence and co-operation to be observed in the two great functions of animal life, and how we are enabled to explain the use of various peculiarities in the structure both of the respiratory and circulating apparatus which are found in the different tribes of animals, all of which, I will endeavour to show, are intended to regulate and modify the distribution of the blood throughout the system, according to the habits and necessities of the different races of organised beings.

Uses of their various modifications.

To effect a variety of purposes in the animal economy, we find that modifications in the inspirations and expirations are constantly resorted to, sometimes the inspirations, and sometimes the expirations, being either lengthened or shortened; by which modifications changes are produced in the quantity of blood within the heart, or in the velocity of the blood's stream. Thus the breathing will be observed to be changed in the acts of swinging, turning round rapidly, standing on the head, or when a person is on board a ship. Respiration is also modified in sobbing, sighing, yawning, laughing, vomiting, and hiccup, all which involuntary acts I will subsequently point out are resorted to by the system for the purpose of adjusting the circulation when it has been disturbed, not only in health, but also in disease.

How the heart's action is changed by respiration—

Such, indeed, is the influence of respiration on the action of the heart, that its movements can be even altered by a voluntary change in breathing; and the ingenious experiments of Sir Benjamin Brodie have shown that, when an animal is decapitated, or the brain under the influence of poison, and the heart has even ceased to beat, its action may be restored by artificial breathing. Thus some persons, by making a very slow and long-protracted inspiration, are able to render the action of the heart so languid that the pulse cannot be perceived at the wrist; and in like manner, by a very quick breathing, the action of the heart may be greatly accelerated.

remarkable cases of.

It is told of John Hunter, when suffering from a disease in the heart, that upon one occasion, on the approach of a fit of syncope, he recovered himself, and absolutely saved his life, by making a violent respiratory effort.

This influence of the respiratory organs on the action of the heart was strikingly illustrated in the case of a lady, whose heart sometimes acted so irregularly that she was frequently apt to fall into a state of syncope; and she accidentally discovered that by the act of *singing* she could prevent herself from fainting. "I will write you," she observed, "something very remarkable about myself, namely, that when my heart is in a great flutter, and I am not certain whether I shall faint away, singing removes it almost directly. One Sunday, when in church, I expected every moment I should be obliged to be taken out, and disturb the congregation, when happily the psalms were beginning to be sung, and I instantly joined in the psalm, and the comfort the act of singing then gave me was almost instantaneous."

A case, in many respects analogous, points out the intimate association of the respiratory organs with the heart. A youth was subject to disturbances in the circulation, which often caused paroxysms of violent spasmodic movements in the muscles of the neck, face, and upper extremities, and the singular circumstance was, that he could prevent the fit by repeating the Lord's Prayer in a very subdued tone whenever he felt its approach.

Whilst such modifications in respiration are in some instances the means of restoring a disturbed circulation, there are others wherein changes of breathing *derange* the functions of the heart. Of this a striking instance occurred in a lady who had a very irritable heart, and who, when accidentally amusing herself with blowing some bird-seed, experienced so great a disturbance in the circulation as to cause a very violent hysterical paroxysm.

From all that has now been said, it may be legitimately concluded that the action of the heart depends upon one of three distinct causes—the stimulus of the blood, the influence of the cerebro-spinal system, or the organs of respiration.

The Pulmo-Cardiac Function.

Besides the two important offices of the respiratory apparatus connected with the circulation of the blood, both of which may be considered as altogether depending on changes in the form and capacity of the thoracic cavities, there is a third and, as I shall endeavour to show, an accessory function, which is performed by the lungs themselves, the pulmonary vessels serving as a *receptaculum* or reservoir for receiving any surplus quantity of blood, whether venous or arterial, which the cavities of the heart cannot admit. Hence, in order to distinguish this function from all the others performed by the respiratory apparatus, I have denominated it the PULMO-CARDIAC FUNCTION.

Origin of the name.

As the supply of blood to the heart can scarcely ever be uniform, unless, perhaps, during sleep, the return of the venous and the exit of the arterial bloods being subject to constant irregularities, it is surprising that physiologists should never have inquired by what means the central organ of the circulation can accommodate itself to such almost incessant variations in its supply of blood.

Nature of this function.

Whenever, from any cause, the systemic blood cannot find

The pulmo-cardiac function described.

a ready exit from the left ventricle, and when, at the same moment, there is no diminution in the supply of venous blood to the right auricle, an accumulation or congestion of blood must then take place within the cavities of the heart; and therefore, in order to prevent such undue accumulation, the effects of which would be more or less injurious, further means become requisite besides the expansive powers of the parietes of the chest.

It regulates the quantity of blood within the heart.

This condition of the heart is constantly taking place; for, as I have already said, unless when the body is in a state of perfect tranquillity, and all its functions undisturbed, the return of the venous blood to, and the exit of the arterial blood from, the heart are subject to constant changes. Every muscular movement, the state of the stomach, the exercise of the mind, the varied positions of the body, all influence, directly or indirectly, both the influx and the efflux of the heart's blood.

Importance of such a function.

It is, therefore, important to discover by what means the heart can accommodate itself to such constant changes in the supply of blood, and how it can prevent those disturbances in the circulation which would be necessarily produced by irregularities in its supply to the different organs. This investigation, we shall find, displays a beautiful, yet no less simple, contrivance for executing what may have appeared to be a complex function of the economy.

The heart's own powers insufficient.

If there be only a slight increase in the quantity of blood within the heart, such additional stimulus, by increasing the vigour of the heart's movements, may, along with the elastic quality of the fibro-cartilaginous portion of its structure, which is placed at the roots of the large vessels, be alone sufficient to equalise the circulation. But if the increased supply of blood to the heart be so considerable that the surplus quantity cannot be received within its cavities, the *lungs* are then required to lend their assistance.

Assistance derived from the lungs.

The structure adapted for this.

To fulfil this *pulmo-cardiac* function, the structure of the lungs is admirably adapted. The pulmonary vessels, being imbedded in a soft and yielding substance, are susceptible of various degrees of distention, so that they readily give way for the reception of any surplus quantity, whether of venous or of arterial blood, and retain it until it can be received within the heart. The very same structure, with which the lungs are endowed to enable the air-cells to accommodate themselves to those differences in the quantity of air which take place during respiration, also enables the pulmonary vessels, in their turn, to accommodate themselves for the reception of the various quantities of blood which may be impelled into them.

Utility of this function.

A function is therefore performed by the respiratory organs which is quite unconnected either with arterialising the blood, with aiding the return of the venous blood to the right heart, or with assisting the circulation in the pulmonary vessels; and when it is considered how often, and by what slight causes, the current of the arterial blood is hindered from leaving the left heart, and how frequently the return of the venous blood is accelerated to the right heart, the *pulmo-cardiac* function must be regarded as one of primary importance.

Influence of the pulmo-cardiac function on respiration.

It exercises, as might be anticipated, a remarkable influence on the function of respiration; for whenever the egress of the arterial blood from the left ventricle is impeded by muscular contractions, and the exit of the systemic blood from the lungs into the left auricle is interrupted, the velocity of the blood in the veins will also be increased, and venous blood must be congested in the pulmonary arteries. Thus, the blood being accumulated in the pulmonary arteries and veins, as well as in both hearts, respiration becomes quickened, and its frequency increased in proportion to the degree of impediment which is offered to the distention of the air-cells; and the hurried respiration will continue until the circulation be equalised, the heart has become tranquil, and the congested lungs have been relieved of all surplus quantity of blood.

Accordingly, it will be found that, unless when the supply of blood to the heart is uniform, as is the case during sleep, respiration is constantly varying: sometimes the inspirations, and sometimes the expirations, are shortened or prolonged, or the duration of the interval between them is changed; all such variations being caused by alterations in the quantity of blood which is contained in the pulmonary vessels.

The Veno-Pulmonary Function.

But whilst the *pulmo-cardiac* function is employed to relieve the heart of any surplus quantity of blood which it cannot receive within its cavities, the *veins* will, in like manner, be found to relieve the pulmonary vessels of any superabundant blood which they are not capable of receiving without interruption to the great function of respiration. This important office of the veins, and which I have denominated the *veno-pulmonary* function, I will endeavour to demonstrate, by pointing out some facts regarding the structure and functions of the venous system, and also by considering some phenomena connected with the circulation which are constantly taking place.

An office of the venous system

When describing the effects of muscular contractions on the circulation, I have shown that certain classes of muscles are employed by the economy to compress, by their contractions, veins as well as arteries; and that both systems of vessels are so placed, in relation to such muscles, as to be compressed whenever these muscles are thrown into action. I also pointed out that, whilst one class of arteries was employed to perform this important office in the circulation, there was another class which was not required to execute that function; these arteries being so placed in relation to the muscles that the contractions of the muscles could not influence the circulation of their blood.

performed by the subcutaneous veins,

The division of the arteries into those vessels which are, and those which are not, influenced by muscular contractions, we shall also find applicable to the *veins*, one class of veins being so situated that the circulation of their blood is affected by the contractions of the adjacent muscles, whilst another class is never under the direct influence of the active organs of motion. Hence, in the limbs, the deep-seated veins which are intermingled with the muscles are influenced by every muscular contraction; whereas the subcutaneous or superficial veins, being placed externally to the *fascia*, are not affected by the action of the muscles of the extremities. Whilst, therefore, the chief function of the veins is to convey the blood back to the heart, there are likewise other offices especially executed by each of these subdivisions of the venous system.

by forming a receptaculum.

That the *subcutaneous* veins perform the office of a *receptaculum*, by receiving any surplus quantity of blood which cannot be admitted into the pulmonary vessels in like manner as we have seen that the pulmonary vessels themselves receive that blood which the cavities of the heart cannot admit, is illustrated by the phenomena which accompany different degrees of distention of these vessels.

This function illustrated.

The most remarkable of those phenomena is what we have constantly opportunities of observing when the regularity of the circulation is disturbed by muscular exertions. If these are made within certain limits, it has been already noticed that the pulmonary vessels, both arteries and veins, are endowed with powers of extension sufficient to contain the additional quantity of venous blood propelled forwards to the right heart, and also of the arterial blood impeded from leaving the left heart. But when the vessels of the lungs become congested, and cannot admit any more blood, not only is the systemic blood driven into those arteries which are compressed by muscular contractions, but the venous blood which cannot find access within the thoracic cavity becomes accumulated and stagnates in the subcutaneous veins.

No more striking example can be given of this office of the subcutaneous veins than their distended appearance in the limbs of a person after making any violent exertion, or beneath the delicate skin of a race-horse after a severe gallop. And in the otter the subcutaneous veins are extremely numerous, evidently intended as a *receptaculum* for the venous blood, which cannot be received by the lungs when the animal is under water.

But neither this accessory function of the subcutaneous

Pulmo-cardiac congestion explained.

veins, the increase in the heart's action, nor the aid which the respiratory organs afford, are always sufficient to prevent a congestion of blood within the cavity of the chest; for, whenever muscular exertion has been violent or carried to its extreme limits, the accumulation of blood, both within the pulmonary vessels and the cavities of the heart, then becomes such, that the balance of the circulating and respiratory apparatus is destroyed, the congestion renders them incapable of sufficiently evacuating themselves, and the accumulation in the vessels of the lungs prevents the inspiration of a sufficient quantity of air for arterialising the blood.

Its pernicious effects.

In this state of congestion it sometimes happens that the pulmonary vessels give way, and a fatal hemorrhage ensues, or death may be caused by suffocation, as sometimes takes place from the convulsive agonies of childbirth. And in animals that have died in the act of making a violent muscular exertion, it has frequently been found that life was not extinguished from the bursting of any of the heart's cavities, as some have supposed, but from their being so much over-distended with blood as to prevent the heart's action, and from the pulmonary vessels being at the same time so much gorged with blood as to prevent the ingress of the requisite quantity of air for the arterialisation of the blood. This condition of the thoracic viscera has been observed in horses that have died suddenly from severe galloping; and in some instances so violent had been the efforts to carry on respiration, that the diaphragm has been found in these animals torn and permitting even portions of the abdominal viscera to pass into the cavity of the thorax.

A congested state of the thoracic viscera from violent exertions, when not carried so far as to destroy life, may, however, go the length of producing such a derangement of the circulation as the respiratory and circulating organs combined have not the power to restore; and although, by a system of *training*, a power of adjusting these organs so as to carry on respiration during such exertions may be acquired to a surprising degree, yet, if the *pulmo-cardiac* congestion goes beyond certain limits, a permanent disturbance of the circulation takes place, and the functions of respiration and circulation are never afterwards perfectly restored.

Accordingly we may observe an almost infinite variety in the period which is required to tranquillise the movements of the heart and lungs after they have been disturbed by any muscular exertion,—that period depending on the violence of the effort as well as on the *condition*, as it is called, of the person by whom it has been made.

Training, explained;

These observations naturally lead us to inquire by what means can a person attain the power of regulating the respiratory and circulating organs so as to be able to continue making great muscular exertions, until his muscular energy is exhausted, or in what consists the art of training? This subject has never sufficiently claimed the attention of physiologists, and no one, as far as I know, except the ingenious Mr. Bell, ever seems to have made even allusion to it, or to have considered whether any changes take place in the physical condition of the thoracic viscera of those who have been trained to perform feats of strength.

(The Anatomy of the Human Body, by John Bell, 1797.)

"Do we not see that boxers and all the tribe of athletics cannot ever make those exertions unprepared? And what is the course of 'training' but a spare diet of generous food, with regular exercise and gradual exertions; till at last the two great functions of respiration and circulation, accompanying each other, are brought to the highest pitch, and the man becomes capable of exertions before impossible or dangerous, now familiar or easy to him?"

A careful consideration of the varied functions of respiration and circulation, along with some points but lately discovered in the anatomy of the respiratory apparatus, will, I am persuaded, enable us to give a satisfactory elucidation of the changes which take place in training, and will also lead to a satisfactory explanation of several symptoms in the diseases of the thoracic viscera which have hitherto evaded pathological research.

its phenomena.

If we attentively examine the nature of training, or putting a person "in wind," we shall find that it consists in so regulating the respirations during muscular exertions that any *pulmo-cardiac* congestion is prevented; and this is effected by permitting the lungs to receive only such quantities of blood during each inspiration as will not destroy the proper adjustment between the respiratory and circulating organs, whilst at the same time a quantity of air is inspired sufficient for the arterialisation of the blood. The muscular movements are thus allowed to proceed until the energy of the muscles becomes exhausted; for, as I have already mentioned, if *pulmo-cardiac* congestion goes beyond certain limits during any muscular exertion, the person becomes exhausted, not from the muscles being fatigued, but from the cavities of the heart and pulmonary vessels becoming so loaded with blood as to interrupt respiration.

An important part of the anatomy of the lungs.

There is a circumstance regarding the anatomy of the lungs, first described by Sir E. Home, which is of importance to notice here, as it appears to me materially to assist in explaining this peculiar feature in the function of the pulmonary apparatus. From his dissections it appears, that in proportion as the air-cells are distended, so is the circulation of the blood in the pulmonary vessels interrupted; and, if the cells be completely distended, the pulmonary capillaries, from the obstruction caused by the over-distended air-cells, cannot transmit the blood to the pulmonary veins. When the arteries of a sheep's lungs were injected, the injection was found to return very readily by the veins; but when the air-cells were previously much distended, the injection could not be then forced into the pulmonary veins.

(Philosophical Transactions, 1827, Part I.)

(See Appendix I.)

It explains the pernicious effects of too full inspirations.

In further illustration of this important anatomical fact, I may remark, that by very full inspirations the action of the heart is diminished, and the shorter and the more frequently the inspirations are made, the more rapid become the movements of the heart; and also, when from disease a portion of lung is no longer capable of assisting in the arterialisation of the blood, that portion which remains sound having an additional duty to perform, respiration becomes increased in frequency, and there must necessarily take place an increase in the heart's action,—a circumstance which may explain that quickness of the pulse which has been considered as pathognomonic of tubercular phthisis.

From the foregoing observations we are warranted to conclude that too full inspirations, by over-distending the air-cells, and thus impeding the pulmonary circulation, will prevent the continuance of any muscular exertion, whilst, if the inspirations be limited so that the air-cells shall not be over-distended, the free circulation through the pulmonary capillaries will not be interrupted, and the muscles will then be enabled to act until their energy is exhausted.

Training modifies respiration.

That *training* consists in a person acquiring a certain control over the respiratory organs, and that one of its essential conditions is to limit the *inspirations*, can be shown by examining the mode in which respiration is performed by those who are properly trained for athletic purposes.

The effects of training illustrated;

in dancers;

It may be remarked, that those who are even best trained for performing feats of strength require great care and nicety in order to adjust the respiratory organs, before making any muscular exertion. The trained dancer commences his performance by increasing the movements of the body in a very gradual manner, and thus establishes an equilibrium between the respiration and circulation, so that afterwards he can perform the most rapid movements, and continue the exertions until his muscular energy is exhausted, without suffering any interruption from the respiratory organs.

in pugilists;

It is the same with the prize-fighter, for whom, to retain his greatest physical powers, it is necessary that the muscular exertions which he is about to perform be at first made only in a very moderate degree; and if, from passion or great excitement, he is induced to make too violent an effort at the commencement of a fight, the necessary adjustment in respiration is destroyed, his breathing becomes laborious, and he cannot avoid failing in his enterprise.

In order still further to illustrate the condition of the respiratory organs which is necessary for allowing the continuance of powerful muscular exertions, I may remark, that the various contrivances which are resorted to for effecting this purpose all act by limiting the inspirations, and thus prevent such a degree of distention of the air-cells as would impede the ready flow of the blood from the pulmonary arteries into the pulmonary veins.

in running a race;

Hence, in running a race, it is found essential that the mouth be kept shut, a sufficient quantity of air entering by the nostrils for the arterialisation of the blood; experience having taught that, if any additional quantity is inspired by the mouth, the proper balance between respiration and circulation is more or less destroyed, and the person is obliged to discontinue the effort. The common practice to effect this purpose is putting a pebble, or some such-like substance, into the mouth, by which the voluntary effort of retaining it keeps the lips closed. And, too, the reputation of Thelwall, a well-known teacher of elocution, was chiefly founded on a mode which he had, in order to learn his pupils to read aloud for a very lengthened period without fatigue, simply by making them *inspire* only through the nostrils.

in reading aloud;

in stammering;

This mode of regulating the respiration was known to Demosthenes, of whom we are told that, in order to correct some imperfection of his speech, he was in the habit of putting pebbles in his mouth; and there are many persons who stammer when they speak, but who are known to sing without any impediment.

in the effects of lozenges;

The effect of *lozenges* in subduing some coughs is, I am inclined to believe, to be attributable to the circumstance of the mouth being kept shut involuntarily whilst the lozenge is retained in the mouth, and thus inspiration is carried on alone through the nostrils. Neither is it at all improbable that, in some of those persons suffering with pulmonary affections who have derived benefit from using the *respirator*, the relief has been obtained by the inspirations being made chiefly through the nostrils.

and in tying a belt round the waist.

Artisans, also, whose avocations require them to make great muscular efforts, are in the habit of tying a belt tightly round their waists, thus preventing too great an expansion of the chest; and when the sailor prepares himself for battle, in order the more powerfully to exert himself at the guns, he ties a handkerchief firmly round his waist, by which, during the excitement of the fight as well as from the powerful muscular exertions which he is compelled to make, the movements of the respiratory apparatus are confined within certain limits, and he is prevented from making such full inspirations as would disturb the balance of the circulation in his chest.

Nicety of training.

The pernicious effects of violent exercise on the circulation, as well as the mode of avoiding them, are well understood by those who professedly train persons for gymnastic exercises, and hence it is by them considered a great nicety in the process of training never to allow *pulmo-cardiac* congestion to be carried so far as to render the thoracic viscera unable to remove without difficulty, whenever the muscular exertions which produce the congestion have ceased, all surplus blood from the pulmonary vessels. For when attention has not been paid to this circumstance, and when from an over-distention of the air-cells the congestion has exceeded certain limits, an embarrassment in breathing continues, and which, in some instances, prevents the person from following such exercises even throughout the remainder of his life.

The same phenomena may be observed in those in whom congestion is caused from having made any violent exertion to which they are not accustomed, and who continue ever afterwards to suffer from a disturbance in the thoracic circulation. The observations, however, which I have to make on this subject will be introduced more appropriately when we come to consider the pernicious effects of violent exercise on the respiratory and circulating apparatus.

Phenomena connected with the Respiratory and Circulating Organs.

There are many important phenomena, as has been remarked, which I am persuaded will admit of a satisfactory explanation, now that the intimate connection between the functions of the heart and respiratory apparatus has been pointed out,—phenomena which, although they are constantly taking place, yet the purposes which they are intended to serve in the animal economy have not hitherto been contemplated, far less satisfactorily explained.

Unsatisfactory result of experiments on animals.

It would have undoubtedly been well for medical science had physiologists, in place of exhausting their imaginations in contriving fruitless and contradictory experiments, and torturing innumerable living animals, been satisfied with observing the various phenomena which are constantly developing themselves in the healthy state of the body, and had they watched with equal care the various changes which these undergo in diseases. Indeed, it is surprising that the different instinctive acts of the economy of which I am about to treat, and which are constantly taking place before us, should not have long ago led physiologists to consider for what purposes, and to investigate how, such various acts were produced; for, on a little reflection, it must have appeared that the uniformity and the similarity in the circumstances under which they were always developed would have led to some explanation of their effects and of their influence upon the system.

Certain acts of the economy never yet explained.

In pursuing this subject, we shall find that similar beautiful provisions to those which the economy possesses for preserving and restoring parts of the body that have been injured or destroyed, are also wisely provided for restoring and sustaining the *functions* of organs or systems of organs when they have been deranged,—all which may, indeed, be considered as so many proofs of a *vis conservatrix naturæ*. When, for example, the bronchi are irritated by a particle of dust, we observe that there is an immediate exudation of mucus, and a violent cough to expel the extraneous substance. And if a mote falls into the eye, there immediately follow profuse lachrymation and sneezing, by which it is expelled; or, if anything offensive is taken into the stomach, there soon follow sickness and vomiting. So, in like manner, we shall find that, whenever the circulation in the heart is disturbed, either by physical or moral causes, changes take place instinctively in the functions of the respiratory apparatus by which the healthy condition of the circulation is again restored.

These acts enumerated;

I shall endeavour to show that laughing, crying, weeping, sobbing, sighing, coughing, sneezing, hiccup, and vomiting are all acts which are resorted to by the economy in order to effect certain changes in the circulation of the blood in the heart for some essential purpose. I shall also endeavour to explain how certain sensations in the head, such as the giddiness felt from swinging, turning round rapidly, or from sudden alterations in the position of the body, sounds in the ears, false images before the eyes, and sea-sickness, depend upon the function of respiration, and are prevented in certain individuals by a power which they possess, or which they may have acquired, of modifying respiration.

they restore a disturbed circulation.

For each of these purposes, however, to which I have alluded, it will be found that only one of the offices of the respiratory apparatus is more especially employed. Thus, full *inspirations* are made in order to relieve the head, because they accelerate the return of the venous blood to the right heart. Deep *expirations* will relieve the left heart of any superabundant quantity of blood which it may contain, and they will also aid the transit of the systemic blood along the great arterial trunks. The *musculo-cardiac* function will at all times, by impeding the transit of the blood in some arteries, increase its quantity within the left ventricle, when the heart is required to act with additional vigour; whilst the *pulmo-cardiac* function will, by regulating the quantity of blood in the heart, prevent congestion, and ward off the pernicious effects of any irregularity in its supply of blood.

By modifying, therefore, the inspirations and expirations, the pulmonary vessels at the same time being capable of receiving various quantities of blood, we perceive how the system itself possesses the means of restoring that balance in the circulation which is so often interrupted by moral causes operating on the heart, and by physical causes acting on the organs of respiration.

Let us consider these phenomena separately, and as they present themselves in the healthy state of the system, which will prepare us afterwards to examine the various modifications which they undergo in the diseases of the thoracic viscera; for it could not be expected that a rational explanation could have been given of the diseased changes in the function of any organ until the phenomena of its healthy state had been investigated.

The movements of the chest which take place during fits of laughter, and likewise in the acts of crying, weeping, sobbing, and sighing, we shall find are all resorted to by the system, in order to effect alterations in the *quantity* of blood both in the lungs and heart, when the circulation has been deranged by mental emotions.

Laughter—its effects on the circulation.

The deep inspirations and the short and frequent expirations made in the act of *laughing* have a direct influence on the heart, increasing the quantity of blood within its cavities in the same manner as the quantity within them is increased by muscular contractions.

This condition of the heart, as might be anticipated, varies according to the violence and duration of the paroxysms of laughter. When these are moderate the mind is only exhilarated, or, to use a common expression, "the heart becomes joyful;" but, if laughing be prolonged beyond certain limits, a series of effects more or less injurious frequently supervene. Pain in the cardiac region and headache then come on, and, if the paroxysm be immoderate, the quantity of blood propelled into the brain is so greatly increased, that the intellectual powers become excited, and sometimes to such a degree as to cause their temporary aberration. Even convulsions follow immoderate fits of laughter; and I have known death take place from excessive laughter caused by *titillation*. A young woman was induced to creep under a bed, and, when secured in that position, her feet were tickled by one of her companions, and such was the violence of the paroxysm of laughter which it produced, that convulsions supervened, which terminated fatally. And we are told that

Case.

Petro Aritius died of a fit of laughter on hearing of the infamy of his sister! Mariotti's Italy, vol. ii.

A disturbed action of the heart is usually observed in those affected with *hysteria*, which may account for the paroxysms of laughter, the hiccup, and many of the more remarkable pathological phenomena which are characteristic of that disease. A lady, of a nervous temperament, always had, when a fit of laughter was prolonged beyond a certain time, a regular hysterical paroxysm.

Effects of laughter on a diseased heart.

Laughter, indeed, greatly disturbs a heart which is already disordered. This was strikingly exemplified in a person who had a disease of the heart, and who never could indulge in laughing without the increased action of the heart by which it was followed causing violent headache. And a youth, who was recovering from a disorder in the heart, on reporting his progress, observed that the symptoms had been much aggravated in consequence of having laughed violently the day previously—an effect of laughing which he had often before experienced.

The sardonic laugh.

There is a laughter that accompanies rage, indignation, and delirium, and which, from its resemblance to the effects of the *apium risus*, a herb of Sardinia, has been called the *risus sardonicus*. "Sardinia," says Solinus, "produces a herb which has this singular property, that, whilst it destroys whoever eats, it so contracts the features, particularly the mouth, into a grin, as to make the sufferer to appear to die laughing."

Crying—its effects on the circulation.

Crying, which consists in a succession of violent and long-protracted expirations, will have the effect, by diminishing the circulation in the pulmonary arteries, of unloading the left heart and large arteries of any surplus quantity of blood, caused by the action of the heart having been disturbed, whether by moral causes or from bodily pain: hence the relief which those who suffer mental affliction or bodily pain derive from crying—an act which is resorted to throughout the whole animal kingdom to relieve the heart from the hurtful effects of pain.

From the same cause arise the great languor in the circu-

Hurtful effects of not crying.

lation, and even the pernicious effects, which have so often been known to follow the endurance of severe bodily pain without crying. A man who made no signs of great suffering during a military flogging dropped down lifeless.

Cooper.

We see many examples of crying in hysterical women, and the screams which are made from fear or from mental agony must have a powerful influence in unloading a congested heart.

Effects of the cries of the infant.

The cries of the infant which are made at the moment of its birth—

> "The piping cry of lips that brook no pain"—
> BYRON—

as the poet has well remarked, have a great influence on the circulation, the violent expirations powerfully contributing to propel the blood through the pulmonary vessels, then only for the first time called on to perform their functions; and the salutary influence of the *cry* is so well known to nurses, that it is their common practice, when they have tied the umbilical chord, or immediately before doing so, to give the infant a "smack," or to sprinkle some cold water upon the face, in order to make it cry!

"When the child is born," John Bell has observed, "the function of the placenta declines exactly in proportion as that of the lungs strengthens. If the child do not breathe freely, the chord will continue to beat, the placenta still continuing to perform the function of the lungs; but when the child begins to *cry* freely, the pulse of the chord and function of the placenta at once cease. If the child breathe freely, but yet do not cry, and you tie the chord, it is instantly forced to cry for a fuller breath! and, if a rash person tie the chord prematurely when the child neither cries nor breathes, he thus cuts off the function of the placenta before the function of the lungs is established, and often the child is lost."

See the Anatomy of the Human Body.

Weeping—its effects on the circulation;

Weeping, also, which consists in irregular respiration, either with or without crying, is an effort or voluntary act made to facilitate the pulmonary circulation, and relieve that congestion in the heart which is caused by grief. "Weeping," observes Haller, "begins with a full inspiration, after which follow short expirations and inspirations. It is finished by a deep expiration, and immediately followed by a deep inspiration."

Hence arise the baneful effects, and the sensation of fulness, "the fulness of heart," and even of pain in the cardiac region, so frequently experienced by those who have not wept when the mind has been greatly agitated.

and of sobbing and sighing.

Sighing appears also to be a movement employed by Nature to relieve the heart from congestion. The full inspirations which are made in sighing, by withdrawing the venous blood from the head, will assist in restoring the balance of the circulation, both within the head and chest, when it has been destroyed by some violent mental emotion or bodily pain.

> "He sighed a sigh so porteous and profound, as it
> Did seem to shatter all his bulk, and end his being."
> SHAKSPEAR.

Effects of vomiting on the circulation—

The influence of *vomiting* on the circulation ought likewise to be noticed, as an instinctive act employed by the economy, not only for the purpose of evacuating substances pernicious to the stomach, but also for assisting the left heart and large vessels to propel the systemic blood when the capillary circulation especially has been disturbed. The same expulsatory effort which removes the contents of the stomach, along with the pressure of the abdominal parietes and the collapse of the walls of the chest, which take place during vomiting, must also have a considerable effect on the circulating apparatus, and, consequently, *spontaneous* vomiting is resorted to by the system, for the relief of some diseases depending upon or caused by a disturbance in the circulation.

in the Asiatic cholera;

In the Asiatic cholera, wherein the blood, from a preternatural degree of viscidity, cannot be circulated with its usual facility, the disease is often accompanied with vomiting, and it is well known, when spontaneous vomiting does take place, that its influence in aiding the circulation of the viscid blood is such, that the patient generally recovers from that formidable malady; and the good effects of artificially producing vomiting in the treatment of *cholera* is well established.

In febrile diseases;

There are likewise many febrile diseases wherein the effects of vomiting are equally manifest; and it may be remarked, that the relief which the act of vomiting affords in such ailments does not arise from the evacuation of any noxious contents from the stomach, but by producing an almost immediate change in the action of the heart and capillary system.

The *nausea* which precedes the act of vomiting, by diminishing the movements of the heart, must also be taken into consideration when endeavouring to account for the remedial effects of emetics, and it has usually been observed, that an emetic which causes a protracted nausea is often a more effectual remedy, in some diseases, than one which produces speedy vomiting. In the use of emetics it is, therefore, essential to discriminate whether it be requisite merely to evacuate the stomach of its pernicious contents, or to act on the disordered organs of circulation.

in syncope;

It may also be remarked, that vomiting frequently takes place whilst a person is recovering from syncope, being then resorted to by the *vis conservatrix* in order to assist in restoring the vigour of the languid circulation.

in sea-sickness;

The fits of vomiting which accompany *sea-sickness* likewise produce temporary relief, by withdrawing venous blood from the head; but, as I shall subsequently point out, no permanent relief can be obtained from sea-sickness until the person acquires a power of modifying his respiration.

in pregnancy.

The sickness and vomiting which so frequently accompany *pregnancy* will, in all probability, be also found to depend on a disturbance in the circulation, and may explain the decided relief which is derived from the abstraction of small quantities of blood from the arm under such circumstances.

Effects of coughing on the circulation;

What I have said regarding vomiting applies also to *coughing*: the act of coughing being resorted to by the system, both for the purpose of evacuating pernicious secretions from the mucous surface of the lungs, and likewise for restoring the thoracic circulation when that has been disturbed. Hence the various coughs and paroxysms of coughing which accompany diseases of the heart. A young lady was subject to a cough for several years, which was always caused by laughter, and which came on in paroxysms so loud as to be heard in distant rooms of her dwelling. (Case.)

Sneezing is by no means an uncommon act in disturbances of the heart. It is an instinctive act, like that of coughing and vomiting, and is not only an effort made to remove hurtful substances from the cavities of the nose, but is also resorted to by the system for restoring the circulation, when that has been disturbed. And of sneezing.

By paroxysms of sneezing the violent expirations increase the velocity of the circulation, and drive the blood to the head, often causing hemorrhage from the over-distention of the vessels of the Schneiderian membrane, in like manner as a paroxysm of coughing causes hemorrhage from the lungs when there has been *pulmo-cardiac* congestion.

There appears to be an intimate connection or sympathy between the heart and the organ of smell, certain odorous substances having a great influence on the heart's action; and the power which sternutatories have in restoring the vigour of the heart during a fit of syncope, and in asphyxia, is well known. Sympathy between the nose and heart.

The phenomena of disease further illustrate this sympathy between the organ of smell and the heart. A youth, whose circulation was disordered, and who was subject to violent paroxysms of convulsions, sometimes had the strongest desire to take snuff, with which he used to fill his nostrils most greedily; and the effect of which was always to excite a paroxysm of his disease. Case.

A young man suffered severely from a malady of his heart, and, during nine years that he was afflicted by it, every few days, and sometimes every day, his nose bled, from which spontaneous hemorrhage he always experienced more or less relief. Case.

Hiccup, which is a sudden sonorous inspiration, seems likewise to be an act connected with some disturbance in the Effects of hiccup on the circulation.

circulation of the blood within the thorax. It is usually preceded by a paroxysm of laughter, and the short violent inspirations which form the most striking characteristic of hiccup will assist in unloading the left heart wherein the blood has been congested. A gentleman had an immoderate fit of laughter which lasted upwards of an hour, and after it had ceased it was succeeded by a violent hiccup, which continued several hours and caused great uneasiness in the chest, which required the application of leeches and the internal use of antimony to relieve.

Hiccup is also one of the last acts of the dying, and it is a striking symptom in fatal strangulation of the intestine.

Modifications of respiration in running, &c.;

Modifications likewise take place in the duration of the inspirations and expirations when a person makes any very powerful but short muscular effort, such as to run, leap, or raise a very heavy weight. In *running* a match, not exceeding one hundred yards, or in leaping, the exertion is accomplished during the period of one inspiration, and the long inspiration made by a pavior or blacksmith, whilst raising the hammer of great weight, is always followed by a violent expiration accompanied with a deep and audible sigh; the effect of which is, by restoring the balance of the circulation, to prevent congestion within the lungs and heart.

in raising a weight.

Sea-sickness explained.

It is from a want of this power of adjustment or co-operation in the respiratory and circulating organs that we can explain how certain individuals suffer from *sea-sickness*. Wollaston observed, that, in those who did not suffer sickness at sea, their respiration was altered. In waking from very disturbed sleep, he found that his aspirations were not made with the accustomed uniformity, but were interrupted by irregular pauses, with an appearance of watching for some favourable opportunity to make the succeeding effort, and it seemed as if the act of inspiration were in some manner to be guided by the tendency of the vessel to pitch with an uneasy motion.

"After I had been harassed," observed that ingenious philosopher, "by sea-sickness for some days, and had in vain attempted to account for the difference between the inexperienced passenger and those around him more accustomed to the sea, I imperceptibly acquired some power of resisting its effects, and had the good fortune to observe a peculiarity in my mode of respiration evidently connected with the motion of the vessel, but of which, in my enfeebled state, I was unable to investigate either the cause or consequence. In waking from a state of very disturbed sleep, I found that my aspirations were not taken with the accustomed uniformity, but were interrupted by irregular pauses, with an appearance of watching for some favourable opportunity for making the succeeding effort, and it seemed as if the act of inspiration were in some manner to be guided by the tendency of the vessel to pitch with an uneasy motion.

"The mode by which I afterwards conceived that this action could primarily affect the system was by its influence on the motion of the blood; for, at the same instant that the chest is dilated for the reception of air, its vessels become also more open for the reception of the blood, so that the return of blood from the head is more free than at any other period of a complete respiration. On the contrary, by the act of expelling air from the lungs, the ingress of blood is so far obstructed, that, when the surface of the brain is exposed by the trepan, a successive turgescence and subsidence of the brain is seen in alternate motions with the different states of the chest."

See Philos. Trans. 1815.

Modes of relieving sea-sickness;

These views of the cause of sea-sickness accord with the means which are usually resorted to for its relief. One of these is to place the body in such a position that the weight of the column of blood in the head will be diminished as much as possible during the "pitching" of the ship; and this may be effected by the horizontal position, and also by placing the head near to the centre of the ship.

by the position of the body;

The other mode of warding off sea-sickness is by resorting to those means which modify the respiration, and by which congestion within the head and the concomitant vomiting are prevented.

by limiting the inspirations.

The common practice of tying a belt tightly round the waist, of avoiding conversation, and of keeping the mouth shut, which those who run races readily accomplish simply by having a small pebble, or such like-substance, constantly in their mouths, all assist, by limiting the expansion of the parietes of the chest, to regulate the breathing in such a manner that the balance of the circulation is preserved in all the different motions and positions of the vessel.

The disagreeable effects of the motion of a ship, by disturbing the circulation of the blood, I have repeatedly known to occur in an aggravated degree in persons who have been affected with some disease of the heart. Such individuals suffered from sea-sickness not only with unusual severity, but had also many uneasy sensations continue, more particularly that of the ship's motion, for a considerable time, even for weeks after having come on shore.

Those who are not accustomed to travel rapidly in a carriage or on a railroad are also apt to suffer from giddiness, or some unpleasant feelings in the head, during a journey; and it sometimes happens that uneasy sensations and feelings of the motion of the carriage continue for several days in those who have had some affection of the heart. On the other hand, as has been already remarked, all these motions will produce exhilarating effects on those who are accustomed to them, and who are in the enjoyment of health.

On a similar adjustment of the respiratory and circulating organs consists the art of *diving*. The power of remaining under water depends on the diver, previously to immersion, inspiring the greatest quantity of air which the lungs can contain, without the distention of the air-cells being to such a degree as to interrupt the circulation through the pulmonary capillaries. Thus he can remain under water till the air which has been inspired is no longer fitted for the arterialisation of the blood; whereas a person who has not, from experience, acquired such a power of adjusting the thoracic viscera cannot remain under water, from the feeling of suffocation immediately succeeding submersion, which is caused by congestion of blood within the pulmonary vessels.

In those animals which can remain under water a considerable time, and in the class of *amphibia*, we find that there are peculiarities of structure contrived either to avert pulmonary congestion or to supply the lungs with an extra quantity of air. Thus, in the *otter* the inferior *vena cava* is enlarged and tortuous, so that when the animal is under water that vein receives a portion of the returning blood, and retains it until respiration is again performed and the pulmonary circulation is established; and this animal also has an immense network of subcutaneous veins which will contribute to perform the same office. In some *reptiles* the trachea where it enters the lungs forms capacious vesicles which serve as a reservoir, enabling the animal to remain under water as long as the air which they contain is sufficient for the arterialisation of the blood.

in the otter;

in some reptiles.

Effect of swinging on the circulation.

Swinging must likewise have the effect of alternately increasing and diminishing the pressure of the blood within the head according to the differences in the weight of its column in the various attitudes which the body assumes when rising and falling in the swing. Whilst the head is ascending there will be little or no change in the degree of pressure which is made upon the brain, as far at least as any alteration in the weight of the blood's column is concerned; but when the feet ascend and the head is placed downwards, then a column of blood will press upon the brain with a gravity in proportion to the elevation of the extremities and depression of the head.

Such increase of pressure on the brain is quite sufficient to account for the giddiness which many experience in swinging, whilst those who do not suffer uneasy feelings avoid them by an involuntary effort in breathing, by which the action of the respiratory organs is modified; for, as has been already pointed out, a certain adjustment in the inspirations withdraws venous blood from the brain at the moment when the column of arterial blood is such as to exercise upon it an undue pressure. This effect of swinging and of turning round rapidly upon the circulation may explain the benefit derived in the treatment of some cases of insanity by employing rotatory motions.

In the same manner we can account for the power which

How the balance of the circulation is preserved in different postures,

some individuals acquire of "standing on the head," as tumblers and actors on the stage, without suffering giddiness or headache. The balance of the circulation in such varied positions of the body is preserved by the inspirations and expirations being so modified that no surplus quantity of blood is permitted to go to the head, but finds a receptacle in the pulmonary vessels.

and modified according to the habits of different animals.

Contrasted with the uneasy feelings experienced in men from changes of posture or unusual motions of the body, it is interesting to observe the perfections in the arrangements of the circulating organs of some of the lower animals, that enable them to perform the various movements which their habits and necessities require. The rapid motions and varying positions of the body of those which live on trees or amongst rocks, the flight of birds, the habits of amphibious animals, all require certain peculiarities in the structure and function of the respiratory and circulating organs, which are not necessary for the human species.

Subject concluded.

Having endeavoured to point out that the *pulmo-cardiac* and *musculo-cardiac* functions, along with the influence which respiration exercises on the circulation, unfold the means which Nature employs for supplying at all times the heart with a requisite quantity of blood, as well as for preventing those congestions to which the thoracic viscera are constantly exposed, it may be reasonably anticipated that a knowledge of these functions will enable us to account for many phenomena in the diseases of the thoracic viscera which have hitherto been inexplicable. Indeed, in almost every affection of the heart we shall find the function of respiration more or less disturbed, the diseases of the heart influencing the functions of the lungs, inasmuch as the diseases of the lungs alter the condition of the heart.

In conclusion, I may remark, that it is by the *musculo-cardiac*, *pulmo-cardiac*, and *veno-pulmonary* functions combined, and also the influence of the inspirations and expirations variously modified, by which the respiratory organs can under all circumstances alter the supply of blood, not only to the heart and lungs, but also to the brain and spinal chord; and, therefore, when we extend our pathological researches to their various phenomena, we must always keep in mind the influence and dependence which the functions of these three vital organs, the tripod of life, have on each other, and that, for duly regulating the circulation of the blood, it is requisite that the brain, as well as the heart and the lungs, should constantly preserve an accordance and co-operation in all their actions, and that, whenever their harmony is interrupted, many pathological conditions supervene, characteristic of and depending on irregularities in the distribution of the vital fluid.

CHAPTER IV.

RECIPROCAL INFLUENCE OF THE HEART AND NERVOUS SYSTEM.

Influence of the nervous system on the heart; influence of the heart on the nervous system; the blood the chief cause of this consent; blood the first element of life; condition of the cerebro-spinal system modified by changes in the functions of the heart; illustrated in sleep and wakefulness; conflicting theories of the nature of sleep; explanation of the author; the phenomena that precede sleep diminish the vigour of the circulation; those that precede wakefulness increase it; the general circulation equalised during sleep; the proportion of the arterial and venous blood changed; the modifications of sleep are important symptoms in diseases of the heart; subject concluded.

Influence of the nervous system on the heart;

HITHERTO we have been contemplating the great function of the circulation of the blood as carried on by a simple hydraulic engine; but, like every other apparatus forming a component part of the animal structure, the heart is under the influence of the nervous system.

how explained;

This influence of the brain and spinal chord on the heart physiologists have accounted for by attributing the involuntary movements of the heart to the branches which it receives from the great sympathetic nerve, whilst those of the par vagum, from its connection with the lungs, stomach, and all those organs associated with the function of respiration, explain how the action of the heart is under the influence of the passions.

illustrated in the effects of the passions.

That the action of the heart is influenced by mental emotions is well known; and it must have been this influence, particularly the effects of joy and grief, which led the ancients to place the seat of these passions in the heart, and to employ the word "Heart" to express the moral sentiments.

It is said of Fontana that he acquired such command over the action of his heart, that he could accelerate or retard his pulse at pleasure; which points out the influence of the brain upon the heart; and such cases must have given rise to the opinion that the heart itself is immediately under the influence of the will.

Heart under the influence of the will.

The remarkable case of Colonel Townsend has been frequently referred to, in order to show the influence of the mind on the action of the heart, though the power which he possessed over it was evidently affected by changes produced in respiration. A few days before his death he could expire when he pleased, and, by an effort, he could come to life again! "Before making the experiment on the day of his death his pulse was distinct, though small and thready, and his heart had the usual beating. He composed himself and lay on his back in a still posture for some time. His pulse sank gradually, till at last it could not be felt by the nicest touch; not the least motion could be felt in the heart, nor the least soil of breath perceived on a bright mirror held to his mouth; not the least symptom of life could be perceived. He continued thus for half an hour; the motion of the heart was then observed gradually to return, and he recovered again, executed some business, and died the same evening."

Cheyne's "English Malady."

Whatever be the influence which the nervous system exercises on the heart, to a much greater degree does the heart influence the nervous system.

Influence of the heart on the nervous system;

In conducting their researches, physiologists do not appear to have duly considered the influence of the heart on the brain and spinal chord; but the anatomical facts which have been pointed out will, I am fully persuaded, enable us to account for many physiological as well as pathological phenomena which have not hitherto been satisfactorily investigated.

See page 38.

The sympathy between particular organs has been supposed to depend chiefly upon the relation which subsists between them through the medium of the nervous system, such organs being supplied with nerves either from the

by the communication of nerves,

same trunks or from anastomosing branches of the same nerves.

and by the blood.

That some organs are intimately associated, and that their various functions co-operate with one another in consequence of direct nervous communication, is quite certain; but there is likewise another source of consent, and this depends on the *blood*. Of the influence of the blood no more striking example can be found than in the heart and brain; for, besides the relation which is established between these two vital organs from the intercourse of nervous fibres, in an equal and, perhaps, even in a far greater degree does this co-operation depend on the *blood*. "Out of the heart are the issues of life." It is the blood that forms the vital link between the heart and the brain. Indeed, the phenomena of life seem wholly to arise from the impression which is made by the blood upon the nervous centres.

Though we do not comprehend what the "mysterious principle of life" is, yet we know that it emanates from the nervous system; and we have sufficient evidence that the nervous energy, sensorial power, or by whatever abstract terms it may be denominated, depends on, and is modified by, the quantity of *blood*, and the regularity of its circulation within the brain; the energy of the brain, like that of other organs, entirely depending on its supply of blood. No more, indeed, can the brain perform its functions without blood, than the heart carry on the circulation without the brain.

Blood the first element of life.

The *life* of a part, it may be truly said, is far more depending on its supply of blood than upon its nervous energy. A part can live without nerves, but without blood it decays. "The blood of it is for the life thereof." The nervous system enables the lungs and the stomach to prepare the blood, but the nervous system cannot do so, unless it has itself a proper supply of the vital fluid.

Dependence of the nervous system on the blood.

The dependence of the brain on the *blood* for the due performance of its functions is illustrated by the effects which changes in the circulation have in causing various states of mind, as watchfulness, irritability, and sopor, as well as those different shades of intellectual energy so remarkable in the same person at different times; and hence we shall find that a vast number of disturbances in the brain's functions entirely arise from disturbances in the circulation, and most of these changes are the effects of some primary affection of the heart.

Illustrations of.

Of the sympathy between the heart and nervous centres there is a striking proof when the action of the heart suffers merely a temporary disturbance; and the phenomena resulting from this consent have not escaped the dramatist when delineating the effects of sudden mental emotion:—

> "A dizzy mist that swims before my sight,
> A singing in mine ears; 'tis strange enough,
> 'Tis slight, 'tis nothing worth, 'tis gone already."
> JOANNA BAILLIE.

Neither is the influence of a temporary disturbance in the heart's action less remarkable on the spinal chord, illustrations of which are afforded in the trembling from fear, and in the involuntary movements of the limbs which so frequently accompany a state of violent mental excitement.

Functions of the nervous system depend upon those of the heart.

As the circulation of the blood in the brain depends upon the function of the heart, the condition of the cerebro-spinal system must necessarily be modified by every change in the heart's action; and our endeavours to investigate the true nature of these phenomena are of essential importance in prosecuting inquiries on the diseases of the heart; for I think it will appear that the aberrations to which sleep is liable, and the various conditions of the intellectual powers during wakefulness, can all be shown to be the effects of modifications in the functions of the heart, and that these changes in the nervous system afford an addition to the catalogue of *symptoms* in the heart's diseases.

Sleep and wakefulness.

Sleep and Wakefulness.

The nature of sleep.

Of all the conditions of the cerebro-spinal system depending upon the heart, one of the most remarkable is that of *sleep;* a condition of that system which is subject to various modifications when the functions of the heart are disturbed.

Natural and perfect sleep is one of the most essential functions of animal life. The mind, like the body, has its seasons of activity and repose; and, whether one or more of the intellectual powers be wearied, these require rest, just as happens with any other part of our physical frame.

" Sleep doth nourish much, both for that the spirits do less spend the nourishment in sleep, than when living creatures are awake, and because that, which is to the present purpose, it helpeth to thrust out the nourishment into the parts."

Bacon, Century I.

Conflicting theories of sleep.

(See Appendix K.)

An inquiry into the nature of sleep is the more important when investigating the phenomena of the cerebral circulation, as some vague hypotheses and most untenable theories have been entertained on the subject by eminent physiologists; and until the errors of such discrepant opinions be pointed out, and the true nature of sleep be revealed, the connection between the heart and the brain, in the disordered states of the circulation, cannot possibly be understood.

Illustrated by the phenomena of waking,

In order to explain the influence of the *musculo-cardiac* function on the circulation, I selected the phenomena which are developed in the act of waking as an excellent illustration of that function of the muscular system; and I likewise endeavoured to explain how all the movements of the body which are made when waking from sleep, such as yawning and stretching the limbs, have the effect of increasing the vigour of the heart, and, consequently, of increasing the impetus of the vital stream in the vessels of the whole cerebro-spinal system.

and by the phenomena which precede sleep.

No less interesting, or more strikingly illustrative of the changes of the circulation in the cerebro-spinal system, produced by the *musculo-cardiac* function, are those phenomena which take place immediately before a person falls asleep, all these forming a powerful contrast in their effects upon the brain and spinal chord to those manifested when a person is in the act of waking; for it will be shown that the phenomena which precede sleep all combine to *diminish* the force of the heart's action, and, consequently, to diminish

These diminish the circulation.

the supply of the systemic blood to the brain; whereas all those phenomena which accompany the waking state contribute to invigorate the heart, and, consequently, to *increase* the flow of the systemic blood to the nervous system.

Phenomena preceding sleep enumerated.

When a person is about to fall asleep, whether he be impelled from mental fatigue, from bodily exhaustion, or from habit, he prepares himself to pass into that state, by bending the limbs, and placing them in those attitudes, and seeking such a position for his whole physical frame, as will relax the greatest possible number of the voluntary muscles. He also loosens, or altogether removes, his garments, so that they shall not cause any obstruction to the circulation in the extremities. He likewise endeavours to prevent the organs of hearing from being excited by selecting a place of tranquillity; and he closes the eyelids to exclude the organs of vision from the excitement of external objects, as well as from the stimulus of light. "Sleep, which shuns the light, embraces darkness, and they lie down together most lovingly under the sceptre of midnight."

Relaxation of the voluntary muscles.

Abstraction of noise and light.

Macnish.

Sleep not produced suddenly.

Further, it may be observed that, when passing from the waking state to sleep, in like manner as has been shown when passing from sleep to waking, the change is not made instantaneously, but requires some length of time. "Thus," observes the illustrious Cullen, "when a person is falling asleep, the sensibility is gradually diminished; so that, although some degree of sleep has come on, slight impressions will excite sensation and bring back excitement which the same, or even stronger, impressions will be inefficient to produce when the state of sleep has continued long, and is, as we say, more complete. In some members it fails sooner than in others, and it is some time before it becomes general and considerable over the whole."

This circumstance, that the brain "does not all at once glide into repose, but that its different organs are necessarily thrown into that state—one dropping asleep, then another, then a third, until the whole are locked up in the fetters of slumber," offers incontrovertible testimony that the brain is composed of a plurality of organs. And those phenomena

Macnish.

which usher in sleep and waking are also manifested in *dreaming*, and in all the varieties of imperfect sleep, as well as in diseases of the heart; for it will be found that, whenever the action of the heart is disturbed, it is not the whole nervous system which is influenced by the altered circulation, but only one or more portions of the brain or spinal chord.

Circulation equalised during sleep.

Reviewing all these phenomena which usher in sleep, we accordingly find that, during calm and perfect slumber, there is a considerable *diminution* in the force of the heart's action, as well as a diminution in the frequency of its pulsations, and consequently there must be a less quantity of blood ejected by each contraction of the left heart. All parts of the body will now receive blood in proportion to the size of the arteries distributed upon them; and none of those differences and irregularities of its distribution to particular organs ever happen during perfect sleep which are so constantly taking place in the waking state, more especially those changes which are caused by the varied functions of the respiratory, digestive, and muscular systems, as well as by mental emotions. So enfeebled, indeed, are the powers of life during sleep, from the diminished vigour of the circulation, that those diseases, the chief character of which is marked by great debility, such as *petechiæ* and gangrene, usually first appear during sleep.

To these changes in the general circulation must necessarily succeed corresponding changes in the sensorium, and when sleep is perfect all the cerebral functions cease. "In sleep there is a suspension of animal life, and during its continuance man is under the influence of organic life alone; it is a temporary metaphysical death, though not an organic one."

Bichat.

Illustrated by the phenomena of waking.

The changes which take place in the brain and organs of circulation when we pass from sleep to wakefulness are no less important in pointing out the true nature of this function than those phenomena by which it is accompanied.

Instead of means being resorted to by the economy to diminish the vigour of the circulation, as on the approach of sleep, changes of a perfectly opposite character take place on the approach of the waking state—changes which have been already shown to *increase* the vigour of the heart. The muscular system, which, during sleep, had been in a state of complete repose, is now thrown into action, the position of the trunk of the body is changed, and the limbs are stretched. In like manner as, when on the approach of sleep, one organ of the brain slumbers after another, so on waking one organ is awoke after another, a certain time being required before all the intellectual powers are revived; and if we are awoke very suddenly out of a profound sleep, "our ideas are exceedingly confused, and it is some time before we can be made to comprehend what is said to us."

See page 50.

Organs of the brain awake in succession.

Macnish.

As all the phenomena which precede sleep must, it is evident, materially contribute to equalise the supply of the vital fluid to every organ, and to every part of the body, they must undoubtedly have also the effect of *diminishing*, in a special manner, the supply of the systemic blood to the brain; and, consequently, the various modifications both of sleep and wakefulness can be most satisfactorily explained by contemplating the corresponding changes which take place in the velocity of the currents of the blood in the cerebro-spinal system. Likewise, as all these modifications of sleep must depend upon changes in the action of the central organ of the circulation, so will each of them become important signs of the state of the heart, both in health and in disease. Indeed, I may here remark, that there are no morbid phenomena connected with the cerebro-spinal system which, when viewed conjointly with those manifested in the other systems of the economy, afford more unequivocal symptoms in disorders of the heart than the various modifications of sleep.

Sleep the effect of a diminished quantity of arterial blood in the brain;

its modifications are important symptoms.

The account which I have now given of the nature of sleep meets with an additional confirmation by reviewing those causes which disturb or altogether prevent sleep, and, likewise, those by which it is promoted.

Sleep—how disturbed or promoted.

The means which are usually resorted to for *preventing* sleep, such as drinking tea or coffee, increase the heart's action, and will, consequently, increase the supply of arterial blood to the brain: whilst those which are employed to *promote* sleep are such as tend to subdue the action of the heart, and thus diminish the quantity of arterial blood which is sent to the head. The practice of immersing the feet in warm water, to which has been added a stimulating ingredient, as vinegar, mustard, or common salt, disposes to sleep by diminishing the quantity of blood within the head, and thus increasing the supply to the extremities. Sponging the body with diluted vinegar, spirits, or salt water, by producing a glow on the skin, also relieves the internal organs of a certain quantity of blood; and taking fluids into the stomach likewise disposes to sleep by diverting blood to that organ.

When the intellectual powers have been kept in a state of excitement, the heart's action is often so much increased that sleep is interrupted, if not altogether prevented, and, therefore, instead of endeavouring to sleep immediately after any active mental employment, if the body be kept for a while in a state of repose, the excited vascular system will be calmed and tranquillised. This effect of mental excitement is remarkable even in children, for it may be observed that when a child falls asleep immediately after any unusual excitement, its sleep is generally disturbed and unrefreshing. The judicious nurse, therefore, allows the excited system to be tranquillised before she permits the child to fall asleep.

ause of
upor.

Contrasted with watchfulness or disturbed sleep, is *stupor* or an unnatural disposition to sleep—a state caused by a very different condition of the circulation in the brain to that which has just been described. In place of an increased supply of arterial blood—the cause of intellectual excitement—there is, in stupor, a congestion of venous blood within the head, a state wherein the veins are preternaturally distended, analogous to the congestion so frequently occurring in the veins of other organs, particularly those of the abdominal viscera.

Sleep is also liable to other disturbed conditions, most of which appear to depend either directly or indirectly on the state of the circulation in the brain, the phenomena of which are, however, very different from the excitement caused by an increased supply of arterial blood, or from the stupor produced by venous congestion.

After describing the sleep of health, an elegant writer reverses the picture and paints with his finished pencil the sleep of disease. "It is short, feverish, and unrefreshing, disturbed by frightful or melancholy dreams. The pulse is agitated, and, from nervous excitation, there are frequent startings and twitchings of the muscles, nightmare pressing like an incarnation of misery upon the frame. Imagination, distempered by its connection with physical disorder, ranging along the gloomy confines of terror, holding communication with hell and the grave, and throwing a discolouring shade over human life." Macnish.

Like other functions of the economy, sleep may, therefore, be either natural or diseased, and, as various changes to which it is liable may be accounted for by changes in the circulation, the different conditions which it presents will afford, as has been already said, important signs in many diseases of the heart—irregularities in the venous circulation within the head being referable to those of the right, and alterations in the arterial circulation indicating changes in the left, heart.

THE

DISEASES OF THE HEART.

CHAPTER V.

OF THE DISEASES OF THE HEART IN GENERAL.

Arrangement of the subject; the pathological doctrines established by induction; phenomena of the healthy circulation; importance of a knowledge of healthy structure; utility of an inquiry into the functional diseases of the heart; frequency of diseases of the heart; state of the heart's pulse long neglected by pathologists; attention paid to it by the Chinese.

Arrangement of the subject.

Before entering upon the consideration of the particular diseases of the heart, I propose to give a general view of their various *phenomena*, of the *causes* which produce them, of the *symptoms* by which they are accompanied, of the principles on which their *treatment* should be conducted, and of their *classification*.

By adopting this plan it has appeared to me that the materials which I have gathered together may be greatly condensed, and that endless repetitions will be prevented,—repetitions which would have been unavoidable had I attempted, when treating of each disease, to enter into every minute detail; whereas, by first giving a *general* view of the nature of all the diseases of the heart, and of the means best adapted for their treatment, such observations will be found applicable to its particular maladies. Thus, instead of being obliged to repeat, when treating of each disease, those rules which ought to guide us in the administration of any particular class of remedies, it will only be necessary to refer to the general observations which have been made. For example, in the employment of bloodletting, the observations on the indications for adopting it, the extent to which it ought to be employed, when local is to be preferred to general bloodletting, are all equally applicable to various affections of the heart, and need only be referred to when treating of each of its diseases. And the same remark applies to the administration of purgatives, sudorifics, and, above all, as we shall find, to the *cardiac* class of remedies.

The physiological doctrines have been established by induction,

The views which have been given of some important phenomena connected with the circulation may be considered as the basis of the pathological doctrines which I will now endeavour to establish; and I cannot help expressing a hope that these views, along with the anatomical facts to which I have alluded, will not be deemed foreign to the purpose of the present undertaking.

and likewise the pathological.

In like manner, therefore, as I have pursued these investigations, by making inductions from observations, the accuracy of which has been universally admitted, the subsequent *pathological* researches have been conducted; collecting and arranging facts, the accuracy of which has already been established, and drawing legitimate conclusions from them in order to elucidate and explain various morbid phenomena.

Phenomena of the healthy circulation explained.

I have already mentioned, that, when seeking for an explanation of certain symptoms which are often present in those suffering from diseases of the heart, my attention was first arrested in a particular manner, and I have subsequently endeavoured to explain these and other phenomena connected with the circulation in the thoracic viscera. Pursuing this field of inquiry, I have endeavoured to show that there are three distinct functions performed by the organs of circulation and respiration, as well as by those of active motion, which enabled me to explain certain phenomena in the healthy state of the system, and by a knowledge of which I now trust to be able not only to elucidate the nature of many disorders, but also to point out a class of *symptoms* which will, I am confident, be found to afford essential diagnostic signs in diseases of the heart.

These elucidate its pathology.

Thus, the function which I have denominated the *musculo-cardiac*, and which I have shown to be employed by the economy for increasing the quantity of blood within the heart, I will now endeavour to point out performs an essential share in the diseased as well as in the healthy condition of the organs of circulation. It will be also shown that the other two functions are of no less importance; the *pulmo cardiac* function regulating the circulation in the lungs and heart, and the *veno-pulmonary* function receiving the superabundant venous blood that cannot find admission into the pulmonic heart. It is to these several functions of the muscles, of the lungs, and of the subcutaneous veins, I will endeavour to show, that we must always refer in order to explain the various changes which are almost constantly taking place in the distribution of the blood to the different organs whenever the functions of the heart are disturbed.

Importance of a knowledge of the healthy structure.

Indeed, how could it have been expected that the phenomena of the numerous disorders to which the heart is subject could have been distinctly understood until the precise nature of its healthy structure and functions was pointed out? For it is surely by an acquaintance with the natural phenomena of the functions of different organs of the body that any satisfactory rationale can be given of their morbid conditions; whilst, at the same time, it ought to be recollected that both the healthy structure and functions of organs have been often revealed by observations on their diseases.

I may take this opportunity of impressing, more especially upon the junior members of the profession, the great importance which may be derived, both from anatomy and physiology, in prosecuting all pathological researches, and the constant reference which is necessary to be made both to the natural structure and functions of organs whenever we attempt to explore their changes from disease. And here, too, I may allude to the impediment which has so often obstructed the progress of medical science from the attempts that have been made to divide it into separate branches, whilst, at the same time, such unphilosophical and narrowed views have greatly contributed to lower in public estimation, and depreciate the value of, a profession the comprehensive knowledge of which is calculated to confer the greatest blessings on the human race.

The functional diseases of the heart;

Though, as I have said, the morbid changes of the different structures which compose the heart, or, in other words, its *organic* diseases, have already been rigidly investigated by many distinguished pathologists, yet of those disorders wherein there is no apparent change of structure, and where only the functions of the central organ of the circulation are disturbed, little has been noticed by those who have professedly treated of the diseases of this important organ. Now, one of the objects which I am desirous to accomplish in this work is to elucidate and explain these *functional* diseases, and to point out the mode of treatment by which they may be relieved, being fully persuaded that the functions of the heart are liable to various disorders, a knowledge of which will be of essential importance in the healing art. And, notwithstanding it be a too general opinion that the organic dieases of the heart are not remediable,* yet those numerous ailments wherein there is merely some functional disturbance are, I may with confidence affirm, most of them, and certainly as much as the diseases of any other organ, within the control of medical treatment.

their importance;

their frequency.

Diseases of the heart are, I am convinced, more frequent than is usually supposed. If we could venture to draw any general conclusions from all that has been said in medical writings as regards their *frequency*, perhaps it would appear that they were not so very common; those chiefly having been minutely described in which the symptoms had acquired a very aggravated character, and wherein some of the heart's structures had been materially changed. But, when we take into consideration all its functional diseases, and, likewise, the fact that there is scarcely any serious malady of the whole frame in which the heart is not more or less affected, during, at least, some period of its duration, it must be admitted that such maladies are much more frequent than is usually supposed.

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* "Complaints of the heart ought to be placed among those affections which, having carried patients as near as possible to the grave, may yet be so remedied as to permit of a long existence." Andral.

> "There is an order
> Of mortals on the earth who do become
> Old in their youth, and die ere middle age,
> Without the violence of warlike death;
> Some perishing of pleasure—some of study—
> Some worn with toil—some of mere weariness—
> Some of disease, and some insanity—
> *And some of wither'd or of broken hearts;*
> *For this last is a malady which slays*
> *More than are number'd in the list of fate,*
> *Taking all shapes, and bearing many names.*"
>
> BYRON.

The heart's pulse long neglected;

attention paid to it by the Chinese.

That disturbances in the heart's functions are very common there is surely no need of any other evidence than a knowledge of the numerous changes which take place in the arterial pulse, such changes always indicating some corresponding alteration in the movements of the heart. It is, therefore, remarkable that while the attention of most pathological inquirers has been assiduously directed to the detection of changes in the arterial pulse when investigating every disease of the body, yet they have seldom deemed it necessary to examine into the condition of the heart itself, although they must be aware at the same time that the arterial pulse is felt for no other purpose than to acquire information on the state of the central organ of the circulation. Indeed, I have a strong conviction that the habit of examining the state of the arterial pulse in place of the beats of the heart has been a fruitful source of error in the practice of medicine; and it may not be unworthy of notice here, as a curious fact, that the Chinese, of whose progress in medical science we know so little, when exploring the condition of a patient, place the hand or ear on the region of the heart instead of feeling the radial pulse.

They excite disease in other organs.

The various interruptions which the heart's action must sustain from the habits and passions of mankind render it not surprising that, from the influence of the blood on every organ of the body, the heart should not only be itself the seat of many diseases, but also that it should become the exciting cause of disturbances in other organs. Every movement of the body, every mental excitement, every disorder in the respiratory and digestive apparatus, every disturbance of the nervous system, causes, as I have already observed, some alteration in the action of the heart, and the various irregularities and unequal distribution of the blood (which inevitably result from these changes) cannot fail ultimately to create derangement of structure, as well as to disturb the function of those organs whose circulation has become embarrassed.

CHAPTER VI.

THE PHENOMENA AND CAUSES OF THE DISEASES OF THE HEART IN GENERAL.

Different causes of disorders of the heart; changes in the quantity of blood in the cavities of the heart; differences in the capacity of the heart's cavities; differences in the structure and functions of the pulmonic and systemic hearts; cardiac congestion; its nature, causes, and phenomena; analogy of congestion to retention of urine; coronary congestion; disorders of the heart from a diminution of blood; from atmospheric changes; from alterations in the qualities of the blood; from the influence of the respiratory, nervous, digestive, uterine and vascular systems; from vegetable and animal substances.

Changes in the quantity of blood.

OF the various causes of diseases of the heart, by far the most frequent, though hitherto the most unsatisfactorily explained, are those wherein there takes place a change in the *quantity* of blood within its cavities; and to this condition of the central organ of the circulation our present inquiries will be particularly directed, for it is one which either precedes or accompanies almost every disease of the heart, and, above all, it is a morbid condition which is quite within the reach of medical treatment to subdue.

The capacity of the heart's cavities differs;

The *capacity* of the cavities of the heart, it has already been observed, differs considerably, not only in different individuals, but in the various states of the circulation in the same person at different times. Not only does the heart throw out more blood at one time than at another, but the force or velocity of the stream will be increased or diminished according to its muscular vigour. Neither does it expel by each of its contractions the whole of its contents; nor does it receive, each time it dilates, all the blood which its cavities could contain. In fact, like the lungs, which are never emptied, and in which the quantity of atmospheric air inhaled by each inspiration and expelled by each expiration is constantly varying, so the heart, which is never quite empty, has the quantity of blood which it alternately receives and expels always changing.

"If," says Hunter, "we suppose that the left ventricle could hold four ounces of blood, it usually contains only three ounces, and will only contract sufficiently to expel *two* ounces." This calculation must, however, be considered as having been made by that ingenious physiologist for the purpose merely of illustration, and it certainly enables us to explain in a satisfactory manner many phenomena of the circulation.

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The quantity of the general mass of the blood is also very different in different individuals, as in fat persons and those who lead a sedentary life compared with those who are muscular, and who undergo great bodily fatigue; and a difference in the quantity of blood is likewise very remarkable in many diseases; all which circumstances have more or less influence upon the functions of the heart.

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But when, from whatever cause, an increase in the quantity of blood in the heart's cavities has taken place beyond a certain limit, and when they have no longer the power to empty themselves sufficiently, the heart may then be properly said to be in a state of *congestion*. The common expressions of a "full heart," or of a "heart ready to burst," are pathologically correct.

auses.

Congestion may be produced either from the exit of the arterial blood being impeded, the influx of the venous blood accelerated, or from the muscular powers of the heart being incapable of sufficiently emptying the different cavities.

On all occasions when there is a temporary increase in the *influx* of the venous blood into the right heart, and at the same time a diminished *efflux* of the arterial blood from the left heart, the pulmonary vessels, as I have observed, possess the power of receiving a portion of such superabundant blood as cannot gain entrance into the cavities of both hearts; and when the accumulation becomes so great that no more blood can be admitted even into the pulmonary

p. 61.

vessels without over-distending them to such a degree as to prevent the bronchi from receiving the necessary quantity of air for arterialising the blood, then such superabundant blood stagnates in the venous system, and there remains as in a reservoir, until the excited heart is able to receive and again restore it into the general circulation.

Illustrated by experiments on living animals,

The condition of the heart, when in a state of congestion, is distinctly shown by experiments that have been made on living animals, and also by observations on the varied phenomena of disease.

(See Lectures on the Vascular System, by James Wilson, 1819.)

On opening the thorax of animals which had been hanged or drowned, Coleman found "the right auricle and ventricle completely gorged with blood, and no contraction of the auricle took place on the application of a stimulus until a vein was opened, and some blood allowed to escape; in a few minutes after which, on the stimulus being again applied, the auricle contracted."

(See "Edinburgh Med. and Chir. Journal," 1836.)

and by the phenomena of disease.

In numerous experiments on animals which were hanged or drowned, Reid found that there was congestion in the pulmonic heart, and that venesection soon after the heart ceased to beat at once relieved the pulmonic ventricle and excited its pulsations; and it is perfectly well known that horses, when they have been so severely galloped as to fall down apparently lifeless from congestion, are speedily recovered by the abstraction of some blood from a vein.

Cases.

The phenomena of a congested heart are no less forcibly illustrated in the human body. A lady, being much agitated, was impelled to walk a considerable distance more quickly than usual. Her breathing became so oppressed, and the beatings of the heart so violent, that she was under the necessity of being taken into an adjacent dwelling, where she was bled at the arm, by which she obtained immediate relief.

See "Dictionnaire des Sciences Méd."

Even an artificial state of congestion has been contrived for the purpose of simulating disease of the heart. Of this two remarkable examples are narrated of French conscripts, and to which I have already alluded, in one of whom the congestion was caused by tying a thin cord round the neck so tightly as to be concealed by the folds of the skin; and in the other a ligature was drawn very tightly round the upper part of each arm. In both cases the impulse of the heart was much increased, and the countenance became purple and swollen, which symptoms disappeared on the removal of the ligatures.

A criminal, who was hanged until she was supposed to be lifeless, recovered after a copious venesection.

There are also many instances of persons with organic affections of the heart who have expired from an over-distention of its cavities, which had been caused by some violent exertion. A gentleman with a diseased heart ran quickly to overtake a coach, and, almost immediately after he got into it, he expired; and a clergyman, who had long suffered from a disordered circulation, when in the pulpit passionately exhorting his congregation, dropped down lifeless!

Analogy of cardiac congestion to a retention of urine.

The effects of congestion of the heart may not, I think, be inaptly compared to what is observed of other muscular organs when exposed to an excess of their natural stimulus, and at the same time are over-distended; as, for example, a retention of urine in the bladder. The urine, which is the natural stimulus of that viscus, if collected in a moderate quantity, causes it to contract; but, if the quantity be increased beyond a certain limit, the power of evacuation is then diminished; and there are persons in whom the contractile power has been so much enfeebled, from some accidental over-distention, that they have long afterwards been able to expel but a small portion of its contents, a certain quantity always remaining in the bladder which could only be removed by a catheter.

Both treated on the same principle.

And the mode of relieving both these organs when in a state of over-distention, it may be remarked, is likewise effected chiefly on the same principle; for, by evacuating the bladder by artificial means, its muscular coat is afterwards enabled to perform its functions, and, by abstracting some blood by venesection, the over-distended cavities of the heart can be, in like manner, enabled afterwards to avert any undue accumulation of blood.

The analogy incomplete.

Though this analogy of a congestion of blood in the heart to a retention of urine be true, the heart, being considered simply as a muscular reservoir, there are other circumstances and other phenomena to be explained when this organ is in a congested state, all of which arise from the more complicated mechanism and peculiar functions of the heart, not only in receiving, but also in mixing the blood, in giving a special direction to its different currents, and in ejecting the systemic blood into the arteries.

The two hearts differ in their functions,

Previously, however, to attempting to give any explanation of the precise state of the heart when, from whatever cause, congestion is established, I will commence this important inquiry by endeavouring to show in what manner and by what means both the pulmonic and systemic hearts perform their respective functions in the healthy state of the system, by which, I trust, that a satisfactory explanation may be given of its diseases.

and in their structure.

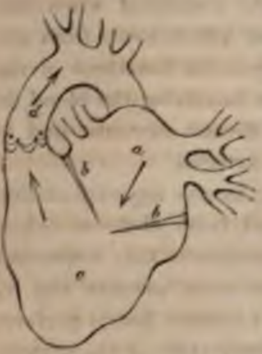
The apparatus of the two hearts, it may be remarked, materially differ from one another, having in essential points very different offices to perform; and, notwithstanding the juxtaposition of these two parts of the same organ, they are perfectly distinct, and are connected together only through the medium of the lungs. The differences both in their structure and functions it is, therefore, important here to explain; for the common notion, that the one performs merely the *great* and the other the *lesser* circulation, I will endeavour to show leads to very erroneous conjectures of the proper offices of each.

Apparatus of the systemic heart.

On examining the mechanism of the left or *systemic* heart, its structure appears admirably calculated to co-operate with the functions of the muscles, for sending to particular organs an additional quantity of blood when that is required. Were, indeed, any further evidence wanting than what has been already given of the purposes which the *musculo-cardiac* function serves in the animal economy, this would be most satisfactorily afforded by contemplating the apparatus of the systemic heart.

Office of the semilunar valves.

Fig. 10.



Whenever the circulation of the systemic blood is impeded through any artery by the contractions of the adjacent muscles, or, in other words, by the *musculo-cardiac* function, the *semilunar* valves at the mouth of the aorta (*d*) effectually prevent any regurgitation into the left ventricle (*c*); so that, on the subsequent contractions of the left ventricle, the systemic blood must be propelled with an additional force into those branches of the aorta through which the circulation has not been impeded by any muscular contractions. If, for example, by some considerable exertion of the muscles of the upper and lower extremities, the current of the blood in the femoral and brachial arteries be impeded, as a reflux of any of the arterial blood into the left ventricle is completely prevented by the semilunar valves, the aorta must necessarily impel that quantity of the blood which would have passed through the vessels of the extremities into the arteries, in the circulation through which there is no obstacle. This, indeed, must be one, and perhaps the most essential, office of the semilunar valves; and such is their construction, and so well are they calculated effectually to resist the reflux of any arterial blood into the left ventricle, that, even in the dead body, an injection thrown into the aorta cannot be forced into the left ventricle.

Hunter on the Blood.

Museum of the College of Surgeons.

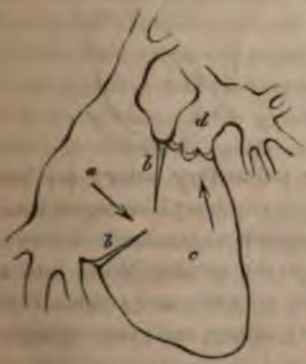
And, the more effectually to give security to the aortic valves, there is in the *shark* a double row of valves—a provision which is, doubtless, required in these animals for guarding against the evil effects of a regurgitation of arterial blood into the left ventricle, the enormous pressure of the deep waters in which they dwell producing an influx of blood from the exterior to the interior vessels of the body.

The mechanism of the aortic valves, therefore, corresponds entirely with the functions which I have demonstrated to be performed by the organs of active motion in the circulation, and it further enables us satisfactorily to explain, when an additional quantity of blood is required for the brain, by what a simple contrivance the necessary supply is effected. Indeed, the structure of the whole circulating apparatus shows that ample means are taken to prevent any derangement in the movements of the blood in particular organs,—the structure of the venous system being such, that in all its subdivisions it is calculated, by the powers of distention in its vessels, always to preserve the balance of the circulation in the arteries.

Office of the mitral valve.

The mechanism of the *mitral* valve (*b*) is calculated to enable it to perform an office equally important in the systemic circulation as that which we have seen is executed by the aortic valves. The auriculo-ventricular aperture being completely closed by the mitral valve (*bb*), any systemic (Fig. 10.) blood in the left ventricle must be effectually prevented from being forced back into the left auricle; and this accurate closure of the mitral valve is a great safety to the lungs, preventing any regurgitation of the arterialised blood into the pulmonary veins.

Fig 11.



Apparatus of the pulmonic heart.

We come next to examine the peculiarities in the mechanism and functions of the right or *pulmonic* heart.

Office of the tricuspid valve: Fig. 11.

Whenever the influx of the *venous* blood into the right ventricle (*a*) exceeds a certain quantity, the auriculo-ventricular aperture is so contrived that its valve, in place of forming, like that of the left heart, an insurmountable barrier to the reflux of the arterial blood, absolutely permits any superabundant venous

They excite disease in other organs.

The various interruptions which the heart's action must sustain from the habits and passions of mankind render it not surprising that, from the influence of the blood on every organ of the body, the heart should not only be itself the seat of many diseases, but also that it should become the exciting cause of disturbances in other organs. Every movement of the body,. every mental excitement, every disorder in the respiratory and digestive apparatus, every disturbance of the nervous system, causes, as I have already observed, some alteration in the action of the heart, and the various irregularities and unequal distribution of the blood (which inevitably result from these changes) cannot fail ultimately to create derangement of structure, as well as to disturb the function of those organs whose circulation has become embarrassed.

certain quantity *may* repass is not impossible, if we can venture to draw any inference from experiments made on the dead body. "The valves of the pulmonary artery," observes Hunter, "do not do their duty so completely as those of the aorta, and they want the *corpora sessamoidea*. If we inject the pulmonary artery towards the heart, it does not so completely hinder the wax passing into the right auricle. Nor are the two portions of injection completely separated, as in the left heart, when the artery is injected from the ventricle."

Office of the tricuspid valve. **Figs. 12 and 13.**

In order, therefore, to permit a regurgitation of the venous blood from the right ventricle into the right auricle, the tricuspid valves are so placed and attached in such a manner to the walls of the right heart, that when the right ventricle is only moderately distended, these valves form nearly a complete partition between it and the auricle. But if the right ventricle be further distended, and its parietes forced to yield beyond a certain limit, the right auriculo-ventricular aperture is then *widened*, the portion of the tricuspid valve attached to its yielding wall is drawn aside, and consequently a free communication is established between the auricular and ventricular cavities.

Fig. 13.

A function of the venous system.

The venous blood being thus permitted to regurgitate from the right ventricle into the right auricle, its reflux will also take place from the right auricle into the *venæ cavæ*; and afterwards it will accumulate and stagnate throughout the *venous* system, in a greater or less quantity according to the degree of obstruction there may be to the circulation.

Difference in the functions of the two auriculo-ventricular valves.

The auriculo-ventricular valves of the two hearts have, therefore, to perform very different offices: in the *left* heart the mitral valve forming a complete barrier to the regurgitation of any arterial blood from the left ventricle into the left auricle; and in the *right* heart the tricuspid valve yielding by any over-distention of the right ventricle, and permitting the venous blood to regurgitate into the right auricle and thence into the *cavæ* veins.

From what has been said, the apparatus of the systemic

See p. 71.

Case.

duce on the respiratory apparatus. When the pulmonary vessels are so loaded with blood that there is a considerable diminution in the capacity of the bronchi, the circulation in the pulmonary capillaries becomes extremely languid, or it may be altogether obstructed, so that, besides a great degree of dyspnœa, or embarrassment in breathing, there is frequently a flow of blood from the bronchial vessels, and such hemorrhage may be so profuse as to cause syncope and sometimes even suffocation. A lady, when walking through a field where some cattle were grazing, was pursued by them, and the exertion she made to save herself was so great that a short time afterwards she expectorated a large quantity of blood, and continued to suffer from a disordered circulation for many years. Another lady expired during the agony of childbirth, and, on examining the thorax, the lungs were found throughout gorged with blood.

Similar effects are frequently produced by rowing and running races; persons being often induced, under such circumstances, to make exertions beyond their " condition."

Indeed, the state of the respiratory function in cardiac congestion indicates a corresponding state of the pulmonary circulation, the breathing being quickened, consisting of very incomplete expirations and short inspirations, the engorged state of the lungs admitting into the bronchi but a comparatively small quantity of atmospheric air.

The same phenomena are observed in animals. A horse fell down lifeless from violent galloping, and the lungs were found to be completely gorged with blood, so as to resemble liver, whilst the heart's cavities were perfectly empty.

In other instances the efforts to respire have been so great, from the engorgement of the lungs, as to lacerate the diaphragm, and even squeeze some of the abdominal viscera into the thoracic cavity.

Congestion arises from various causes.

Cardiac congestion may also be produced by other causes besides inordinate muscular exertions. Indeed, the injurious effects of violent mental emotions, the suppression of periodical discharges, changes in the density, temperature, and chemical qualities of the atmosphere, as well as the agency culation of the blood in the pulmonary capillaries must necessarily be proportionally retarded; so that the velocity of the blood in the pulmonary veins will then be diminished, and there will, at the same time, be a corresponding diminution in the momentum of the systemic blood.

The fatal effects of congestion.

Hitherto I have been considering the condition of the heart when congestion has not advanced beyond what may be considered its *first* degree; but, when it proceeds further, important changes then take place, both in the circulating and respiratory apparatus—changes which cause those disturbances that create the most alarming symptoms, and, in some instances, even prove fatal.

See p. 25.

On a former occasion I observed that, by an undue exercise of the *musculo-cardiac* function, serious injuries were sometimes inflicted on the heart's structures, the congestion from such violent muscular efforts causing the valvular apparatus to be lacerated, the *columnæ* to be torn, and in other instances the parietes of the heart and aorta to burst. A man fell from a great height and was taken up lifeless, and, on examining the body, the pericardium was found gorged with blood which had escaped through fissures both in the right auricle and ventricle. Another man fell from a height, upwards of forty feet, and died in an hour. The mediastinum was filled with blood, and there were two fissures at the commencement of the descending aorta, from which the blood had escaped. A youth playing very eagerly at tennis was suddenly seized with a "reeling" in the head, difficulty of breathing, and syncope. He suddenly expired some years afterwards, having, during the intermediate period, suffered from a disordered state both of the pulmonary and circulating apparatus. It was discovered that his death had been caused by the bursting of a small aortic aneurism within the pericardium, and which had doubtless arisen from the over-exertion he made at the beginning of the illness, producing such a degree of congestion as to injure the coats of the aorta.

Cases.

State of the respiratory organs.

No less severe are the changes which congestion of the heart, caused by violent muscular efforts, sometimes produce on the respiratory apparatus. When the pulmonary vessels are so loaded with blood that there is a considerable diminution in the capacity of the bronchi, the circulation in the pulmonary capillaries becomes extremely languid, or it may be altogether obstructed, so that, besides a great degree of dyspnœa, or embarrassment in breathing, there is frequently a flow of blood from the bronchial vessels, and such hemorrhage may be so profuse as to cause syncope and sometimes even suffocation. A lady, when walking through a field where some cattle were grazing, was pursued by them, and the exertion she made to save herself was so great that a short time afterwards she expectorated a large quantity of blood, and continued to suffer from a disordered circulation for many years. Another lady expired during the agony of childbirth, and, on examining the thorax, the lungs were found throughout gorged with blood.

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Congestion arises from various causes.

Cardiac congestion may also be produced by other causes besides inordinate muscular exertions. Indeed, the injurious effects of violent mental emotions, the suppression of periodical discharges, changes in the density, temperature, and chemical qualities of the atmosphere, as well as the agency of many vegetable and mineral substances, all disturb the functions of the heart, causing changes in the quantity of its blood. A congested condition of the heart may, likewise, arise from alterations in the form of its cavities, or of the great vessels emerging from them, or from artificially obstructing an arterial trunk.

Nature of congestion illustrated by

In conclusion, I may briefly recapitulate that the exaplanation which has been offered of the condition of the heart, when in a state of congestion, accords with the physiological symptoms accompanying it, with the appearances which have been observed in the congested hearts of living animals, and with the artificial means by which it can be relieved.

the physiological symptoms which accompany congestion;

1st. Of the physiological symptoms which accompany congestion, the most striking is an increase in the impulse of the heart, and a corresponding diminution in the force of the arterial pulse,—the *increased* impulse of the heart being caused by the additional effort necessary in order to empty itself of the accumulated blood,—and the *diminution* in the force of the arterial pulse arising from the diminished power of the heart to circulate the blood through the arterial system.

the appearances in living animals, and

2ndly. I have already noticed the circumstance that in animals, when the heart has become congested from hanging or drowning, the congestion of the right cavities is very apparent, and when to such a degree as to impede the action of the heart altogether, the abstraction of some venous blood has the immediate effect of restoring the heart's movements.

the means relieving it.

3rdly. The effect of venesection in relieving cardiac congestion is also confirmatory of the explanation which I have now given of this condition of the heart. No sooner is a quantity of blood abstracted from a vein, than the arterial pulse begins to acquire additional *vigour*, and the impulse of the heart to *diminish*; the increased vigour acquired by the heart being always in proportion to the diminished action of the arteries. If, however, the depletion be carried still further, then the vigour both of the arterial and cardiac pulse is lessened; and finally a state of syncope may supervene.

Congestion of the Coronary Vessels.

The cavities of the heart having become thus congested, we are next led to inquire into the state of the circulation of the *coronary vessels*,—the nutrient arteries of the heart itself; Page 15. for, as has been already shown, the effects of the *musculo-cardiac* function are not only to increase the quantity of blood within the cavities of the heart, but, also, to increase the flow of blood into those arteries which are *not* compressed by the contractions of the adjacent muscles. The circumstance that the coronary arteries arise from the aorta on the *distal* side of the semilunar valves renders it evident that these vessels must participate in every change of the circulation of the blood in that part of the aorta; and their orifices being so large, in proportion to the calibre of the vessels, and having a trumpet shape, they are admirably calculated for receiving both the stream of blood passing directly from the left ventricle, during the systole of the aorta, and, also, of receiving the retrograde current, when the semilunar valves are closed, during the diastole of the left ventricle.

Thus there is secured a constant current of blood into the coronary arteries—a stream flowing into them both during the systole and the diastole of the heart—which could not take place did these arteries arise from the aorta on the *ventricular* side of the valves; for, if we could suppose such a structure, it would then be impossible for any of the retrograde stream of the aortic blood to flow into the coronary arteries during the closure of the semilunar valves.

Here we have another proof of the simplicity in the means which the economy employs, and how *two* most important functions are executed at the same time by the same physical apparatus,—the very means which are resorted to in order to increase the blood in the cavities of the heart being also those which increase the influx of the vital element into the coronary arteries; so that, when the heart is required to propel an additional quantity of blood, its muscular structure is, at the same moment, provided with an additional supply of blood, and is thus enabled to act with increased vigour.

Coronary veins congested.

The circulation in the *coronary veins* will also be more or less influenced by changes in the quantity of blood in the heart's cavities, as well as by the congested state of the coronary arteries; for, as the great coronary vein opens directly into the right auricle, the flow of its blood into the auricle will be impeded in proportion as that cavity is congested.

Pathological inferences.

Such an over-distended state, both of the coronary arteries and veins, must, undoubtedly, give rise to some of those peculiar symptoms which may be observed accompanying a congested heart; and it is by no means improbable that, in many cases of cardiac congestion, after the superabundant blood has been removed from the heart's *cavities*, a congestion of the coronary vessels may still continue, and ultimately cause diseased changes in the muscles, as well as in the other structures of the heart.

Effects of a Diminution of Blood on the Heart.

Heart disordered from a diminution of blood

The action of the heart is changed by whatever causes a *diminution* in the quantity of its blood; the diminution, however, seldom takes place to such an extent as can properly be said to constitute a permanent disease.

In anæmia.

Disturbances of the heart from a diminution in the quantity of its blood may be observed in those who have suffered from a profuse hemorrhage, and likewise in persons of an enfeebled constitution, in whom the quantity of the general mass of blood is below the common standard.

Extent to which the elements of life may be diminished.

It is interesting to remark to what an almost inconceivable extent the stream of arterial blood which leaves the heart can be diminished without causing any very considerable effect on the general system, and how even life itself can be in some instances sustained when either the left auriculo-ventricular or aortic orifice is so much contracted as only to allow but a very small stream of blood to pass through them. It would appear that the functions of all the most important organs of the body may be imperfectly performed, or they may even be altogether suspended without destroying life. Thus the lungs have been often found very extensively disorganised, admitting only a small quantity of air; one hemisphere of the brain has been entirely changed, the liver greatly diminished in bulk, one of the kidneys completely destroyed, the stomach able to digest but a small quantity of food, the bowels constipated for many weeks, and yet these changes may take place without causing serious injury to the general system. So, in like manner, we shall find that the heart may be able to circulate only a small quantity of blood, or the blood may be greatly vitiated in its qualities, and yet life shall not be extinguished.

Effects of Changes in the Qualities of the Blood on the Heart.

Diseases of the heart from changes in the blood;

The state of the blood has long been supposed to have a great influence on the heart, and to be the cause of many of its maladies. Its increased action in fevers, the disturbed state of its functions in chlorotic patients, in those suffering from jaundice, scurvy, and cachectic diseases, in persons whose constitutions have been much debilitated, and likewise in cases of malformations, are all examples of disturbances in the heart caused by changes in the *qualities* of the blood. Such changes in the qualities of the blood are not, however, limited to causing changes in the heart's functions alone, but produce a variety of disturbances in the different organs and systems of organs, more especially in the cerebro-spinal and respiratory systems, as well as in the organs of secretion and of excretion.

in the Asiatic cholera;

The changes of the blood in Asiatic cholera affect greatly the action of the heart. The escape of the serous part of it into the alimentary canal, and the extreme thickness of what remains in the veins, render its circulation very difficult, and cause that congestion in the heart, as well as in the portal system, which forms such remarkable features in that fearful malady.

The colour of the blood which is artificially evacuated in inflammatory diseases indeed shows how much the disordered state of the circulation in these ailments depends on the condition of the vital fluid.

The state of the blood itself, as well as the action of the heart, is sometimes changed by violent mental emotions, so that the treatment of such cases ought to be conducted with a view to alter the qualities of the blood, as well as to tranquillise the action of the heart.

Disorders of the heart are also caused by those particular states of the blood which give rise to the various local inflammatory affections which so frequently succeed smallpox, measles, scarlatina, and other exanthematous diseases. They are likewise common in persons afflicted with gout and rheumatism, especially when these diseases are translated, or where there is a *metastasis* to the heart. Specific diseases, as scrofula, scirrhus, fungus hæmatodes, and fungus melanodes likewise, though very rarely, affect the structures of the heart.

in exanthematous diseases;

in gout and rheumatism, scrofula, &c.;

I have already observed how small a quantity of blood is requisite for the preservation of life. The vital functions would also appear to be carried on without any very sensible effect on the general system when the qualities of the blood itself are greatly altered, and this we see strikingly exemplified in those cases of malformation of the heart where the arterial and venous bloods are mixed.

Experiments on living animals have shown the remarkable effects which may be produced on the action of the heart by artificially mixing different substances with the blood.

from substances mixed with the blood.

The effect of injecting common *salt* into the sanguineous system, in the Asiatic cholera—a disease, as I have already said, wherein the blood is greatly changed and the action of the heart interrupted from its vitiated qualities—is a striking proof of the influence which changes in the blood cause on the functions of the heart. And Magendie injected a pint of tepid *water* into the veins of a hydrophobic patient, who was in a hopeless condition, after which "his mind, which was in a state of rage and fury, became tranquillised as by enchantment."

Stevens on the Blood, 1832.

The fatal effects of the introduction of atmospheric air into the cavities of the heart, through a vein, has been long known, and frequently employed for destroying horses; but it has only of late years been ascertained that the accidental entrance of air into the wound of a vein, in the neck, made during a surgical operation, causes almost immediate death; the fatal effects, however, are not produced by any change in the qualities of the blood, but by the air entering into the right auricle, there acting as an extraneous matter, and causing a mechanical impediment to the circulation of the blood.

Dupuytren.

Effects of Disturbances of the Nervous System on the Heart.

Heart disordered by the nervous system.

Of all the different causes which disturb the functions and create disorders in the heart, there are none more frequent than affections of the nervous system.

I have already remarked that diseases of the heart cause disorders of the brain and spinal chord, and so, also, it will appear that affections of the cerebro-spinal system are frequently the cause of diseases in the heart. We have a striking proof of diseases of the brain causing disturbances of the heart in apoplexy and in injuries of the nervous centres,—in all which cases remarkable alterations take place in the heart's functions. Indeed, it seems to me extremely probable that the great bodily pain and the "shock" occasioned by severe accidents produce their injurious effects, by primarily disturbing the functions of the central organ of the circulation through the medium of the nervous system. This reciprocal influence of these two vital organs depends, however, on two very different causes,—one arising from the sympathy which has been already mentioned as subsisting between the heart and brain in virtue of the communication of their nerves, and the other is derived from the influence of the blood upon the brain. So that *there are two perfectly distinct classes of those affections of the heart which depend on, or are caused by, disorders of the nervous system.*

Influence of the passions on the heart

The effects of the different *passions* on the heart are well known, and allusions to their influence are found in the sacred writings:—"A joyful heart," says the apostle, "causeth good health, but a sorrowful spirit drieth the bones."

Those persons who are of an irritable disposition, or who are of the nervous *temperament*, generally have the action of the heart easily disturbed; and, *vice versâ*, an excitable state of mind is a very common symptom of a disordered heart.

may either increase or diminish the action of the heart.

It may be likewise observed, that the effects of mental emotions on the circulation are very different according as the mind is excited or depressed by them. In the exhilarating and violent emotions the force of the heart is increased, but in the depressing passions its power is diminished; and these opposite conditions of the heart are marked by corresponding differences in the circulation—an increased circulation being accompanied with a flushed countenance, wakefulness, restlessness, headache, and fever; and a diminution in the heart's action, with a pallid countenance, sleep, coma, and stupor.

It is, indeed, extraordinary to what degree the vital powers appear to be able to support the system by their influence on the heart. "Courage arises out of the consciousness of strength, and a person's strength is in proportion to the activity with which the heart propels the blood towards all the organs."

Richerand.

The lives of mariners and soldiers afford innumerable examples of the courageous and the brave undergoing almost incredible fatigue, and overcoming apparently insurmountable privations and difficulties.

"Spectator," No. 349.

It is told of Mulei Moloc, Emperor of Morocco, that "he was aroused to make extraordinary efforts in the last battle which he fought. Spent with disease and borne on a litter, perceiving his troops to give way, though very nearly in his last agonies, he threw himself out of the litter, rallied his army, and led them on to the charge, which ended in a complete victory to his party! He had no sooner brought his men to the engagement, than, finding himself utterly spent, he was replaced upon the litter, and, laying his finger on his mouth to enjoin secrecy to his officers who stood around him, he died a few moments after in that posture."

Case.

No less powerful is the influence of the passions in subjugating disease, of which medical writings afford many examples. An officer on board Lord Howe's ship had been for some time confined to his bed from a severe attack of gout; but on the 4th of June, when they were preparing for action, he arose from his bed, fought gallantly, and never suffered from gout after that eventful day!

Case.

"A gouty person who was condemned to lose his head, as they carried him out in order to be executed, received the unexpected news of his pardon, which had so remarkable an effect upon him, that, although he was quite exhausted with the pain of the gout, and had lost the use of every limb, yet he got up on his legs immediately, and walked with remarkable quickness and agility; and he lived many years after without having the least touch of the disorder."

Van Swieten.

Case.

The effects of mental emotion are likewise strikingly manifested in those who possess a power within themselves—a peculiarity in their moral constitution—which enables them to withstand and to recover completely from wounds and injuries such as would be fatal to those of an opposite temperament, and also to resist the ravages of disease, and absolutely to prolong life itself. An interesting youth, when in the last stage of pulmonary phthisis, expressed a great desire that his life should be protracted until he became of age, in order that he might dispose of his property in a manner he greatly desired. Contrary to the opinion of all around him, he expressed the utmost confidence that his wish would be realised, and he felt as if he had a power within himself to prolong his existence until the wished-for period arrived. The requisite legal deed being prepared and [illegible], when the hour arrived that he reached his [illegible] he with a firm hand affixed to it his signature and almost immediately afterwards expired!

Those, too, I have said who are suffering from disease of a [illegible] character, but who have, notwithstanding, full confidence in their ultimate recovery, will often linger, it is well known, under severe bodily affliction for a far more protracted period than the desponding or hopeless sufferer.

This influence of the mind in sustaining the heart's action we see also strikingly exemplified in women during parturition. Though they may often express great fear and apprehension of their approaching confinement, and even augur fatal consequences, yet, when the period arrives, it is very extraordinary to witness the confidence which they suddenly acquire, and the courage with which they endure all the sufferings and agonies of childbirth; and no sooner does the infant come into the world, than the mother, elated with joy, at once forgets all her past sufferings and former fears, and clings with rapture to her child!

The influence temporary or permanent.

But the influence of the exciting passions on the heart is not only temporary, but is sometimes so violent as to create a permanent disturbance in the circulation; and many instances are recorded by historians, as well as in medical writings, where the action of the heart has been so greatly changed from a violent emotion as suddenly to destroy life. Even joy, which has, when moderate, such a benign influence upon the system, when excessive has been frequently known to prove fatal. A criminal who was condemned to death, on receiving unexpectedly the intelligence of his pardon, suddenly expired. "A young Russian nobleman was made prisoner by a tribe of Tartars. He was the only son of a fond mother, who, on receiving the intelligence of his captivity, was plunged into the deepest affliction. Having succeeded, after incredible perils and sufferings, in making his escape, he unexpectedly arrived at his mother's abode, and, on entering the room where she was, the shock was so great that she dropped down lifeless!"

Fatal effects of the exhilarating passions.

Corvisart.

Case.

"Her flaw'd heart
(Alack too weak the conflict to support)
'Twixt two extremes of passion, joy and grief,
Burst smilingly." SHAKSPEAR.

Anger, likewise, causes a great increase both in the frequency and in the force of the pulsations of the heart, and sometimes to such a degree as to produce fatal congestion.

In this case the cardiac congestion will be first caused by the influence of the nervous system; whereas, afterwards, it will be more or less increased by the violent muscular movements which accompany rage, and by which both the courage and strength of the whole frame are greatly increased.

Effect of the depressing passions on the heart.

The effects of the *depressing* passions on the heart present a striking contrast to those which are caused by exhilarating emotions. That vital element which I have remarked to be so powerful in giving strength and vigour to the circulation is here wanting, and there is a condition of the heart quite of an opposite character. The capillaries are emptied of their blood, the stream of blood in the arteries has its momentum diminished, and the heart itself becomes congested, palpitating in proportion as it finds difficulty to propel its contents through the arterial and capillary systems.

Fear has a powerful influence upon the heart's action, and, whilst the exciting passions increase the vigour of the circulation, fear diminishes the powers of the heart; hence the paleness of the cutaneous surface, and the cold and shivering, which accompany terror.

> "I have a faint, cold fear thrills through my veins
> That almost freezes up the heat of life!"—SHAKSPEAR.

So great, indeed, is the influence of fear in diminishing the action of the organs of circulation, that cases are recorded in which considerable hemorrhages were arrested by sudden fear.—

Richerand.

"Every being that is feeble is timorous, an inward feeling warning him that he does not possess sufficient strength to resist it."

Effects of fear. (Cases.)

Fear, and the other depressing passions, perhaps even much more frequently than the exciting emotions, lay the foundation of diseases of the heart. The wife of a respectable farmer suffered some years from an affection of the heart, which was caused by having her sleep often interrupted during several months from the constant dread of incendiaries. A nurse, whose sleep had been hourly and often very suddenly interrupted during some months, suffered from a severe disorder of the heart. A lady, from the continued fear of shipwreck, to which she was exposed for eight days, and who never slept during that period, had for a considerable time afterwards a disordered action of the heart.

and of moral depression.

The absence of that moral influence which sustains the heart's action and fortifies the physical frame to resist injuries and disease, renders all wounds and injuries less supportable, the body also more susceptible of contagious diseases, and their effects, when they do happen, more severe.

Case.

The surgeon has constant opportunities of observing the difference in the effects of operations performed on the timid and on those who have great courage; and I have repeatedly witnessed patients die from operations whose death was entirely occasioned by excessive fear. A youth, before submitting to the operation of lithotomy, took farewell of his mother, and assured her that he should not recover. He expired a few days after the operation, and I could discover no apparent cause for his death.

Equally remarkable are the effects of wounds received in the field of battle. The hospitals of a conquered army generally exhibit a scene of great moral depression, and many of the soldiers die from wounds which did not appear to be of a dangerous character; whilst in the hospitals of the victorious the wounded not only recover from frightful injuries, but, even in the midst of the most severe bodily suffering, they exhibit gaiety and cheerfulness, entertaining the most perfect confidence in their recovery.

Effects of grief;

Sudden *grief* and long-protracted sorrow are, I am sure, the cause of disorders in the heart in a vast number of individuals. The effects of sudden grief, like those of fear, consist in a diminution of the vigour of the circulation in the arterial and capillary systems, with a corresponding congestion in the heart, and sometimes to such a degree as to produce syncope; and those effects we may observe in every possible degree, according to the intensity of the passion. The diminution of all the vital powers in a woman who is subdued by grief forms a striking contrast to the violent and hurried muscular efforts which a man makes when he is enraged.

l effects

Whilst the increased flow of blood and congestion in the head during rage have often proved fatal, the diminution in the action of the heart from mental affliction may go so far as to extinguish life. A young woman, apparently in perfect health, on receiving unexpectedly the account of her mother's approaching dissolution, fell on the ground lifeless! Many similar cases are on record, and it is not long since the wife of a criminal dropped down dead after bidding her husband a last adieu!

Long-protracted sorrow has, also, a powerful influence on the heart, causing, imperceptibly, cardiac congestion, and gradually destroying the vigour of the whole frame.

> "Of grief subdued
> There comes a token like a scorpion's sting;
> Scarce seen, but with fresh bitterness imbued.
> And slight withal may be the things which bring
> Back on the heart the weight which it would fling
> Aside for ever." BYRON.

s.

An amiable woman lost suddenly one of her children, and her grief was so intense that she fell into a profound melancholy, could not weep, seldom spoke, and for several years afterwards she suffered from a disorder of the heart.

A gallant young officer fell at the battle of Waterloo, and his father, on receiving the intelligence of his son's fate, was seized with an uneasy feeling in the cardiac region, which never subsided, and he died many years afterwards of a disease in the heart.

fects of
orous sub-
tances.

Stimulants applied to particular nerves may also influence the action of the heart, and there are some *odorous* substances which cause a diminution of the heart's action the moment they are brought into contact with the Schneiderian membrane; and this effect sometimes takes place to such a degree that the vigour of the circulation is so greatly diminished as to cause syncope.

e page 75.

Some odorous substances act as stimulants, and increase the action of the heart, and hence they are employed to restore vigour to a circulation; and others increase the circulation, the force of which has become diminished. Of this we may daily see examples in cases of syncope relieved by the vapours of *ammonia* applied to the nostrils, and the exhilarating effects of taking *snuff*, which, in all probability, arises from the influence which tobacco has upon the action of the heart.

Influence of the cutaneous surface on the heart.

The *cutaneous* surface exhibits a great influence on the heart, and sometimes, when the skin acquires a morbid sensibility, this sympathy is so remarkable as to cause a disturbance in the heart's functions.

Effects of titillation.

There is no more striking proof of the consent between the heart and the skin than the effect of *titillation*. When employed within certain limits, and so as to occasion laughter, titillation is accompanied merely by a temporary increase in the action of the heart, as I have formerly stated; but, if carried further, the laughter then acquires the character of hysteria; and, if it be still longer persevered in, convulsions may be ultimately produced; and instances have occurred where it has been carried so far as even to prove fatal.

See page 74.

Effects of pain.

The vigour of the heart is diminished by long-continued pain, and when that has been sudden or very severe, such as often happens from accidents, gunshot wounds, or surgical operations, the "shock" is sometimes so great as to render its impulse scarcely perceptible, or even diminish it to such a degree as altogether to destroy life.

Many instanes will be subsequently mentioned of the baneful influence which the passions have on the circulation, and of their being often the cause of permanent and organic diseases of the heart; and it must undoubtedly have been this well-known influence of the mind upon the heart which has led the word "heart" to be figuratively used in common language as the seat of the moral sentiments.

The word heart used figuratively.

Fatal effects of passion on a diseased heart.

The effects of the passions on the heart are still more remarkable when the heart is previously in a diseased condition; and so great is this influence, that there are many instances of persons afflicted with a diseased heart who have perished suddenly from some violent mental emotions. Examples, indeed, are not very rare where, on inspecting the bodies of those who have died from sudden passion, it has been found that the heart had been previously diseased.

Case.

Of this fact the death of John Hunter is a striking example. Having long suffered from a disease of the heart, he expired immediately after great excitement in the board-room of St. George's Hospital. A man perished suddenly in a violent dispute with one of his comrades, and after his death it was discovered that he had a disease of the heart, which must have been of very long duration.

Corvisart.

Fatal effects on dramatic performers.

These effects of violent passion have been so studiously imitated by dramatic performers of excellence, that they are known to have experienced, when upon the stage, even all the ill effects which such emotions produce on the circulation when naturally called into action.

Case.

We are told of an eminent actor on the Irish stage, who had long suffered from a disturbance in the heart, that, in performing, under more than usual excitement, the part of *Justice Woodcock*, he had scarcely finished the first lines,

> "I courted a lass that was froward and shy,"

when he fell down in a state of insensibility, and almost immediately expired! We are also told that, while the celebrated actor Palmer was performing the part of the *Stranger*, he became so impassioned that immediately after reciting, "There is another and a better world," he dropped down lifeless!

Effects of Changes in the Respiratory Organs upon the Heart.

Influence of the respiratory organs.

See page 78.

Formerly it has been remarked that, when conducting our inquiries on the diseases of the heart, we ought only to view them in conjunction with those of respiration. The diseases of both these vital organs, like their functions, are so intimately blended with each other, that whatever disturbs the functions of the one, cannot fail to influence those of the other. So that in tracing the *causes* of the diseases of the heart, as well as those of the lungs, it is in many cases no easy matter to discriminate in which organ the disease had commenced; for diseased lungs will disturb the heart, and a diseased heart will disturb the lungs.

Heart disturbed by disease of the lungs.

A healthy condition of the lungs being absolutely necessary for the due performance of the *pulmo-cardiac* function, any morbid state of the respiratory apparatus which interrupts the free circulation of the blood through the pulmonary capillaries, or which prevents the lungs from arterialising the blood, must necessarily cause some derangement in the action of the heart; and this is one reason why diseases of the lungs create a much greater disturbance in the function of the central organ of the circulation than diseases of the same kind, and of equal extent, cause in other organs of the body. The effect of a less quantity of blood being circulated through the lungs when portions of them are disorganised will be the same on the systemic circulation; and thus a diminished quantity of blood circulating withing the thorax accounts for the pathological fact, that the hearts of those who perish from pulmonary phthisis are usually of very small bulk.

When alluding to the reciprocal influence of the respiratory and circulating organs, I mentioned the remarkable changes which modifications in respiration were capable of producing on the action of the heart, and how much the function of circulation depended upon the integrity of the lung; from whence it may be rationally anticipated that diseases of the lungs will in like manner be the cause of disturbances in the heart. Thus it may be explained how relief is obtained in the more severe cases of cough by the application of leeches to the cardiac region, and likewise how the cough is mitigated by the use of nauseating doses of antimony. Indeed, it must happen that in all those diseases where changes have taken place in the structure of the lungs the derangement they produce in the pulmonary circulation cannot fail to exert more or less influence on the functions of the heart.

See page 59.

There are also diseases of the lungs which produce a considerable influence on the action of the heart. In hooping-cough, for example, it often happens that, from the interrupted circulation in the pulmonary capillaries, the heart also becomes congested.

Violent exertions of the pulmonary apparatus, such as are sometimes made in crying, singing, public speaking, and playing on wind instruments, have all been known to cause diseases of the heart. The movements of the chest in weeping, hiccup, and vomiting, have likewise a great influence on the heart's functions; and I formerly endeavoured to show that these were instinctive acts employed by the economy to assist in restoring the balance of the circulation when it has been temporarily disturbed in the healthy condition of the body.

See page [illegible].

Now, it not unfrequently happens that, if any of these acts be continued beyond a certain limit, they produce pernicious effects on the heart's action. Immoderate fits of laughter, I have mentioned frequently, bring on hysteria and also convulsions, which have in some instances been known to proceed to such a degree as even to prove fatal. Weeping and crying also greatly disturb the circulation when they are long continued.

See page [illegible].

On the other hand, as shall be hereafter pointed out, each of these several acts will be often found to accompany disorders of the heart; being resorted to by the *vis medicatrix*, in like manner as I have shown that they are employed by the *vis conservatrix*, to relieve some disturbances in the circulation, which are so frequently taking place when the functions of the heart are disordered.

Effects of inspiring certain substances:

The action of the heart suffers various derangements from substances which are imbibed by the lungs during respiration, and some medicines, exhibited in a gaseous form, can be inhaled and conveyed to the blood in the pulmonary capillaries.

Thus, too, *ether* and *chloroform* are first absorbed by the lungs and mixed with the blood, causing remarkable effects upon the cerebro-spinal system, more especially on the *sensory* column of the spinal chord.

The flushing of the face, the great mental excitement, or even aberrations of intellect, produced by inhaling the *nitrous oxygen gas*, also afford a remarkable instance of a disturbance in the action of the heart from chemical agents brought in contact with the mucous surface of the bronchi; and most noxious gases probably cause their deleterious effects by their influence on the heart.

Effects of Changes in the State of the Atmosphere on the Heart.

Alterations in the state of the atmosphere cause disturbances in the functions of the heart; and these may arise either from changes in the density, temperature, or chemical qualities of the air.

from descending below the surface of the earth;

A disturbance in the heart's action is manifested when a person *descends* far below the surface of the earth, such as into a deep mine, the weight of the atmosphere, from its undue pressure on the bronchi and exterior of the body, interrupting the functions and producing congestion of the respiratory as well as of the circulating organs.

from ascending a great height;

The effects which are produced on the heart and lungs by *ascending* high above the surface of the earth had always been supposed to be chiefly caused by the expanded air containing a less proportion of the materials requisite for the arterialisation of the blood, until the matter was lately put at rest by the testimony of persons who had ascended in a balloon much higher than the loftiest European mountain. In them the breathing was in no manner quickened—a proof that the rapidity of the circulation and respiration on ascending a mountain depends not on the rarefaction of the atmospheric air, but on the effects of the excessive muscular exertion which is required to make the effort.

from changes of temperature.

The action of the heart also undergoes considerable modifications from changes in the *temperature* of the atmosphere; and these changes may disturb the functions of the heart either by their influence on the cutaneous or gastro-pulmonary surface.

Effects of heat,

The exposure of the body to a *warm* temperature not only increases the heart's action by exciting the nervous system, but also, by causing an expansion of the mass of blood, it increases the vigour of the circulation.

Those who are suffering with affections of the heart, it may be often observed, have the symptoms most severe in warm weather, or when residing in a warm climate. I have frequently known persons supposed to have some pulmonary disease, but in whom the heart was primarily affected, to have their ailments increased by residing in a warm climate, an atmosphere equally beneficial to those who are suffering from diseased lungs.

On the other hand, those persons whose circulation is languid suffer much in cold weather, whilst a warm climate has the effect of invigorating the heart.

and the different states of the atmosphere.

The various conditions of the mind and the degrees of intellectual energy which many persons experience in different states of the atmosphere depend greatly, I am persuaded, if not altogether, on the influence which these have on the circulation.

Some of these effects of the different states of the atmosphere upon the heart appear to depend greatly on the influence of electricity, whilst others seem to arise from causes of which we are unable to give any satisfactory explanation.

"In the comparative analysis of air produced on the Alps and in the marshes of Lombardy there was found in each the same quantity of oxygen; and yet those persons who breathe the former enjoy robust health, whilst the inhabitants of the marshy plains are pale, emaciated, and habitually lead a languid existence."

[illegible]

Effects of cold on the heart,

A great disturbance of the heart may be also caused by the application of cold either to the cutaneous or to the gastro-pulmonary mucous surface.

when applied to the cutaneous surface.

The influence of exposing the surface of the body to a cold atmosphere, and of breathing cold air, on the action of the heart are well known; and the change which is thus produced in the balance of the circulation is proved by the effect of cold when applied to the feet in preventing sleep and in causing headache, and also by the powerful influence which warming the legs and feet have—the *pediluvium* and the *maniluvium*—in promoting sleep and in relieving those headaches which are accompanied with coldness of the limbs.

The pernicious effects of cold, when applied to the skin, on the organs of circulation are often observed to cause general fever, and also local pains which have the character of muscular rheumatism.

Rationale of these effects illustrated.

Severe effects of cold on the cutaneous surface may also be sometimes observed from sleeping in a cold and damp bed, the cold producing in such cases a great diminution in the capillary circulation, and a corresponding congestion in the interior of the body, especially within the heart. Accordingly the good effects of artificial vomiting in this state of the system are derived from the influence which the act of vomiting has in restoring the disturbed condition of the circulation. A gentleman when travelling was put into a bed which felt so cold and damp that he was induced to throw aside the sheets and lie between the blankets. On the following morning he experienced a sensation of cold throughout his whole body, and likewise a severe pain in the back of the neck and head, which he attributed to the coldness of the pillow; and these symptoms had continued unabated when I saw him, nine days after the commencement of his illness. He then complained of great tenderness of the scalp and back of the neck, and he had never felt warm, notwithstanding the temperate state of the weather, since receiving the chill. The radial pulse was small and contracted, but the cardiac pulse was vigorous. The exhibition of an *emetic,* and one full dose of calomel a few hours afterwards, had the almost immediate effect of restoring the balance of the circulation, causing heat and moisture on the skin, and completely alleviating the local pain.

by emetics.

Case.

The condition of the heart and capillaries in the cold stage of *ague* has a striking analogy to that which I have now alluded to, and the operation of an emetic in that disease—a remedy the efficacy of which is so universally acknowledged—produces its beneficial effects on similar principles. (a)

Effect of bloodletting in ague.

In like manner may be explained how benefit is derived during the cold stage of ague by venesection—a practice employed by the late ingenious Dr. Mackintosh. The abstraction of even a very small quantity of blood when the heart is congested must enable that organ to eject its contents with greater vigour, and consequently to propel them more effectually into the capillary system, at that time deprived of its natural quantity of blood.

and in the Asiatic cholera.

The use of venesection in the early stage of Asiatic *cholera* admits of a satisfactory explanation on the same principle; and the cause of its hurtful effects in the latter stages of the disease is equally apparent; for whilst, at its commencement, there is great congestion of the heart without any apparent change in the constitution of the blood, that congestion may be relieved by venesection; but when the blood has changed its physical qualities and become viscid from the loss of serum by its enormous secretion into the alimentary canal, then the circulation in the heart, instead of being facilitated after venesection, becomes more languid, and the fatal effects of the disease are accelerated.

When extreme cold produces sleep or torpor, the heart, as well as the other internal viscera, is greatly congested, and, the vigour of the circulation being consequently diminished, the brain must necessarily receive a diminished supply of blood; hence sleep, and even death, are sometimes caused by cold.

The state of torpor from cold is the most perfect sleep that can be imagined, all the functions appearing to cease except circulation, respiration, and absorption.

Effects of cold on the alimentary canal;

Still more pernicious effects on the heart arise from cold applied to the mucous membrane of the *digestive canal.* Drinking cold water, when the body is overheated, I have known to cause very serious disturbances in the heart; and in those cases where death has followed eating *ice,* the fatal effects may be satisfactorily accounted for by the cold producing congestion of the heart.

(a) "It is, indeed, probable that the vomiting which takes place during the cold stages of fevers is one of the means employed by Nature for restoring the determination to the surface of the body."—CULLEN, XLIII.

Fatal effects of cold drinks.

Cases.

A boy when overheated from play drank a tumbler of cold water, and in half an hour he began to complain of an uneasy feeling in his chest, an embarrassment in his breathing, and a great increase in the impulse of the heart, which continued for several days, until he was relieved by venesection. A young lady had, after supper, danced a quadrille, and had just partaken of an ice, when she was suddenly taken ill, became insensible, and she expired in a few minutes

Case.

No less remarkable are the effects of cold upon the functions of the heart when suddenly applied to the mucous membrane of the intestinal canal, and in one well-known instance a nobleman died suddenly after having used an enema of iced water.

Effects of eating hot substances.

Very *hot* substances taken into the stomach have a powerful influence on the action of the heart; and hence the common practice of taking warm drinks in order to act upon the circulation, particularly upon the functions of the cutaneous capillaries.

When food is taken of a very high temperature, which sometimes happens from inadvertence, severe effects on the condition of the heart ensue. A youth swallowed greedily a small portion of hot potato, and he immediately fell down senseless, and in this state he remained about ten minutes. On recovering from the syncope, he felt great pain in the cardiac region, which was succeeded by palpitation and epistaxis, difficulty of breathing, and cold extremities; and in this state he continued nine years, at which period I first saw him, when he was suffering from great disturbance in the circulation.

Cases.

A footman, when carrying a dish of boiled turnips, which were extremely hot, was tempted to eat one, which he swallowed very hurriedly to avoid detection, and he expired in a few hours.

Effects of Changes in the Digestive Organs upon the Heart.

Influence of the digestive organs.

Derangement in the functions of the digestive apparatus is another, and also a very frequent, cause of disturbance in the action of the heart.

Case.

Food of an improper quality, or food not properly digested, deranges the action of the heart. A gentleman, when travelling in a coach, ate a small quantity of baked meat, which was followed by all the usual symptoms of indigestion, besides which a great irregularity in the action of the heart and an intermitting pulse continued several days.

When there is a febrile state of the system, or when the body is much debilitated, the presence of even a very small portion of animal food in the stomach will sometimes cause great disturbance in the action of the heart; and in those cases of fever where there has been a "relapse" of the febrile symptoms, these seem to be usually produced by a disturbance in the circulation caused by improper food.

The retention of an unusual quantity of excrementitious matter in the large intestines sometimes creates a great disturbance in the heart's action, and in other cases this sympathy between the heart and stomach is exemplified by the effect of a purge, which diminishes the vigour of the heart and creates as much depression as would be in some persons produced by a copious bloodletting.

Worms in the intestines have often been known to cause palpitation.

Many of those vegetable and mineral substances which act upon the circulation, and are first received into the alimentary canal, produce their influence on the heart either after they have been absorbed and mixed with the blood, or through the medium of the nervous system; and their effects may either be injurious, or they may be employed as remedial means for diseases of the heart.

When endeavouring to trace the causes and discover the precise nature of diseases in the chest, it is in all cases essential to examine the condition of the digestive organs; for it often happens that their derangement is accompanied with so great disturbances in the circulation as to lead them to be mistaken for a serious disease of the heart. A lady, who died of a cancerous pylorus, suffered so much from a deranged circulation, that, after several careful stethoscopic examinations, several physicians pronounced that the symptoms were caused by an organic affection of the heart.

Case.

The effects of vegetables and minerals on the heart.

The influence of some vegetable as well as some mineral substances, when received into the stomach, on the action of the heart, is very remarkable, and is of great importance to be kept in mind when treating the diseases of this organ, irregularities in the action of the heart which have been taken for serious diseases being sometimes traced to the accidental employment of such substances for the treatment of other complaints.

Vegetable substances.

One common cause of a disturbance in the action of the heart is the use of *tea*, particularly green tea, which in many persons has a powerful influence on the circulation. *Coffee* also produces great nervous excitement from its effect on the action of the heart, and I have observed some persons, whose hearts were diseased, suffer much from the use either of tea or of coffee. A gentleman of a plethoric habit could at any time so disturb the action of his heart as to cause hemorrhage from his nose by drinking a cup of coffee.

Case.

Opium also, when administered in improper doses, frequently disturbs the heart's action, and, by producing restlessness, prevents its anodyne effect on the nervous system.

Digitalis, too, the opium of the heart, has been much employed to subdue the action of the heart in those diseases wherein that organ has been preternaturally excited; and *belladonna* acts in like manner very powerfully on the heart.

The effects of *hellebore* in disturbing the action of the heart are so remarkable, that soldiers and seamen, wishing to be discharged from the service, have been frequently known to employ it in order to counterfeit a disease of that organ.

There are, as I shall have occasion afterwards fully to explain, other substances which, when taken into the stomach, mitigate or subdue the heart's action; and these form an important class of remedies for the treatment of its diseases.

Mineral substances.

Of the mineral substances, the preparations of *lead*, of *antimony*, of *zinc*, of *copper*, and of *iron* have the most powerful influence on the actions of the heart. The acetate of lead has been much used to check hemorrhage; and the preparations of antimony so powerfully subdue excited action of the heart, that they are often employed instead of bloodletting for relieving inflammatory diseases.

Effects of mercury on the heart.

Observations on the Lues Venerea, by John Pearson.

The use of *mercury* is another cause of disorder of the heart, that mineral in some instances acting as a poison and "producing depression of strength, a sense of anxiety about the precordia, frequent sighing, trembling, a sense of coldness, sometimes vomiting," and, added to these symptoms, a frequent and quick pulse.

Derangement of the *biliary* secretions is no less frequently the cause of disturbances in the action of the heart; and the irregularity in the heart's action which so commonly precedes a paroxysm of gout, and which is accompanied with great derangement in the digestive organs, is in all probability entirely owing to this circumstance.

The influence of the stomach on the heart during the digestive process is very considerable, and any repletion is apt greatly to aggravate all the symptoms of a disordered heart. After a meal, when the stomach is distended, there is often a very considerable derangement in the circulation, the face becoming flushed with heat, and the extremities becoming pale and cold from the unequal distribution of the blood.

The relative position of the two organs will explain how in the horizontal position, especially when lying on the back, the replete stomach will, by its pressure, interrupt the heart's movements.

Flatulency is a condition of the digestive organs which, above all others, causes a disturbance in the circulation, and which, perhaps, more frequently produces a disturbed sleep than even repletion, or the presence of undigested food in the stomach.

Nausea and *vomiting* have a very powerful effect upon the heart's action; these being resorted to by the *vis medicatrix*, and being likewise employed as therapeutic agents, to relieve disturbances in the circulation; whilst they also sometimes materially derange a heart that is already diseased.

The injurious effects of nausea and vomiting we see frequently in persons who suffer from sea-sickness.

Cases.

Dr. M. had been, for many years, subject to increased action of the heart; and after being violently sick at sea, in coming from Leith, he felt the motion of the ship continue about ten days; and during the same period he complained of singing in the ears when he sat down after walking and when he rose out of bed.

A gentleman suffered four weeks with an increasing giddiness and feeling as if on board a ship, and which came on after having been very sick at sea.

A young lady, who had long suffered from a diseased heart, died suddenly, during a voyage in a steam-vessel.

Effects of Changes in the Vascular System upon the Heart.

The arterial system.

Changes in the functions of the *arteries*, it might be anticipated from their dependence on the heart's action, must also have a reciprocal influence on those of the central organ of the circulation; and accordingly we find that diseases of the arterial trunks, or when one is artificially obliterated, cause more or less disturbance in the action of the heart. In cases of aneurismal arteries, the heart's movements are often greatly deranged, particularly towards the latter stages of the disease.

Influence of the capillary system.

The consent between the *capillaries* and the heart, especially those of the cutaneous and gastro-pulmonary mucous surface, renders the heart greatly affected in disorders of those systems of vessels; and such disturbances of the heart are exemplified in all those inflammatory affections wherein the action of the capillaries is deranged, and which are marked by a chill or rigour, by paleness of the integuments, by heat, flushing, and profuse perspirations.

(See p. [illegible].) A diminution in the quantity of blood in the capillary system produced from cold, I have already noticed, causes a corresponding congestion in the heart.

and venous system. Many diseases of the veins have also more or less influence on the circulation, especially on that of the right heart.

It is a curious pathological fact, that inflammation of a vein, caused by a wound, generally extends along the internal coat of the vessel towards the heart; but in venesection in horses, where the opening is usually made into the external jugular vein, if phlebitis supervenes, which is not a very unusual occurrence, the inflammation of the internal tunic of the vein does not extend along its ramifications towards the heart, but along the trunk of the vein to the head.

Effects of Changes in the Genito-Urinary System upon the Heart.

Influence of the uterine system on the heart. Another, and by no means an unusual, cause of a disorder of the heart is a morbid condition of the *uterus*, the heart sympathising in a remarkable degree with the uterine system.

In health, the uterine functions being so intimately connected with the organs of circulation, we naturally expect to find that disorders of the uterus will have a powerful influence on the action of the heart; and hence in painful menstruation, at the period of the cessation of the menstrual flux, and especially during gestation, the functions of the heart are often greatly disturbed.

We likewise find that many affections of the uterus are relieved by those medicines, such as the preparations of iron, zinc, and copper, all of which act directly on the organs of circulation. The sickness and vomiting which so frequently accompany pregnancy, I have already mentioned, (See p. 70.) seem to depend on a disturbance of the heart; and we can thus explain how relief is derived from the abstraction of a small quantity of blood when employed under such circumstances. (a)

The *urinary organs* are often sympathetically affected in disturbances of the circulation. Nothing has been considered more characteristic of the *nervous* temperament than a copious secretion of pale urine; and it is a striking feature in hysteria, in which ailment the organs of circulation are more especially affected.

When, besides the disorder of the heart, there is derangement in the digestive organs, particularly the liver, the urine is in small quantity, and becomes high-coloured, depositing a more or less copious sediment; and the absence of such a change in the urine affords a proof of the disordered circulation not being caused by any disturbance of the digestive apparatus.

Effects of Hereditary Diseases upon the Heart.

Hereditary causes.

Besides those disorders which are caused by changes in the qualities of the blood, there is an *hereditary* predisposition in the heart, as in all other organs, to particular diseases. That there are diseases of the heart of an hereditary character we have many instances recorded by the earlier writers, and abundant examples have fallen within my own observation. It may, indeed, be offered as a general remark, that in no race of mankind, in no family, is there not some imperfection in their organisation, as well as a predisposition to some particular ailments, or to diseases of some particular organs. Many branches of some families we may frequently observe affected with diseases of the brain, such as apoplexy or hydrocephalus; other families with diseases of the lungs, as pulmonary phthisis; and others are particularly subject to diseases of the liver.

(a) "Les parties de la génération dans l'un et l'autre sexe ont une action bien marquée sur le cœur. Combien de fois l'usage trop fréquent des plaisirs de l'un sur l'autre n'a-t-il pas occasioné ou des syncopes ou des palpitations. N'est-il pas aussi affecté dans les femmes qui éprouvent des affections hystériques par maladie de l'utérus ou des autres parties de la génération ?"—Portal., t. iii., p. 73.

"The colour of the skin and hair," observes Corvisart, "the features, the expressions of the countenance, the voice, the general proportions of the body and stature, the peculiarities of form, the gesture, habits, disposition, and taste, peculiarities in the sight and hearing, the temperament—in short, all the physical and moral qualities descend more or less from parents to their children."

These remarks strictly apply to the heart, that organ being often met with diseased in numerous branches of the same race. There can be no more striking proof of the hereditary nature of some maladies of the heart than the well-known fact that, in our royal family, George II., George IV., William IV., and the Duke of York all died of diseases of this organ.

Diseases of the heart confined to mankind.

Diseases of the heart may be considered almost exclusively incidental to mankind. In domestic animals, such as the horse, which is much exposed to inordinate muscular exertions, the heart is frequently found in a diseased condition; but in wild animals diseases of the vascular system have seldom or never been observed.

CHAPTER VII.

SYMPTOMS OF THE DISEASES OF THE HEART IN GENERAL.

The physiological and the anatomical symptoms; the important addition of the physiological symptoms to semiology; the physiological symptoms disregarded by Laennec; unfavourable influence of this opinion; table of the physiological symptoms.

THE symptoms which accompany diseases of the heart arise not only from changes recognisable in the heart itself, but, likewise, as I will endeavour to show, from disturbances in the functions of those organs and systems of organs with which the heart is associated, and with which it co-operates in executing the great functions of life; for whenever, from any cause, the action of the heart is changed, and the blood is no longer duly distributed throughout the body, the disturbances which an irregular or altered circulation produces in the various organs become, all of them, *symptoms* of the heart's diseases. Nothing is, indeed, more remarkable, when we contemplate the pathological condition of the human frame, than to observe these assemblages of symptoms in its numerous maladies which are caused by differences in the supply of blood to particular organs.

The two classes of symptoms, the physiological and anatomical.

The symptoms of disorders of the heart, like those of other organs, may be, with propriety, divided into two separate classes, the general or *physiological*, and the local or *anatomical;* the first class of symptoms consisting of those which are caused by disturbances in the different systems of the economy, in the cerebro-spinal, in the respiratory, digestive, genito-urinary, vascular, and muscular systems; whilst the second class of symptoms comprehend those changes which take place in the impulse, sounds, sensibility to the touch, form, and position of the heart.

The physiological symptoms considered.

Let us commence our inquiries on this subject by considering the *physiological* symptoms; and I am induced to adopt this arrangement for several reasons, more especially because the functional diseases of the heart form the most important part of this work, and these disorders, as I will point out, are chiefly characterised by this class of symptoms; whereas the local or *anatomical* symptoms are more characteristic of changes in the structure of the heart, or of its organic diseases.

Their addition to symptomatology.

The senses prone to error.

To me, indeed, it appears that the symptoms which may be derived from a knowledge of the influence of disturbances of the heart on the different systems of the economy are far more essential for establishing a correct diagnosis of these diseases than the anatomical symptoms, of which I shall speak hereafter. At all events, the physiological symptoms must be admitted to form an important addition to semiology, and it must also be granted that all those symptoms the presence of which is made known to us by the patient himself deserve to be far more relied upon for their accuracy than those which are recognisable only by the senses of an observer. The senses, indeed, are very prone to error, of which we daily meet with abundant proofs in the discrepancy of the opinions formed by different eminent men, even in cases of external diseases, where every opportunity is afforded of rigidly examining them by the senses of both sight and touch.

The physiological symptoms neglected by Laennec.

What I have now said is, undoubtedly, taking a very different view of the importance of the physiological symptoms from that which has hitherto been generally entertained, especially by Laennec, whose researches on the diseases of the heart have been so highly appreciated, but who appears to me to have erred, when, attempting to give an undue importance to the physical signs of diseases of the heart, he altogether disregarded and endeavoured to undervalue the importance and utility of the physiological symptoms.

"The true signs of organic affections of the heart are derived from percussion, but above all by auscultation; and besides these signs, which are purely physical, *some* *physiological symptoms, caused by disturbed functions, and, taken by themselves, extremely vague*, can sometimes acquire a degree of certainty which they had not before possessed." Laennec, tom. ii., p. 382.

The influence of this opinion of Laennec is the more to be regretted, as it has had the effect, not only of impressing upon the minds of other inquirers that the physiological symptoms are of little value, but his views seem to have created an insurmountable barrier to all future investigations upon this subject. Nay, further, from such an unfavourable impression having been created by so great an authority, his followers have paid their almost undivided attention to the physical signs of the diseases of the heart; so that the evils which have arisen from this neglect of the physiological symptoms have been very injurious; and all who have been engaged in the practical duties of their profession must have become acquainted with numerous instances of the most serious errors and of the most discrepant opinions given by those who have confided on auscultation in forming a diagnosis of the diseases of the heart. The physical signs in revealing organic diseases of this organ are, undoubtedly, of value; but, when we endeavour to discriminate its various functional disorders, auscultation is, comparatively, of little import; whilst we shall find that the physiological symptoms afford far more certain guides, and enable us to follow, in such cases, a decisive system of treatment.

CHAPTER VIII.

SYMPTOMS OF DISEASES OF THE HEART DERIVED FROM THE CEREBRO-SPINAL SYSTEM.

The symptoms in diseases of the heart derived from the cerebro-spinal system; erroneous opinions of nervous diseases; table of the symptoms; symptoms arising from changes in the proportions of the arterial and venous bloods, and from morbid changes in different portions of the brain; those derived from changes in the spinal chord; Sir Charles Bell's discoveries illustrated; symptoms derived from the ganglionic system; the particular symptoms considered.

Symptoms derived from the cerebro-spinal system.

Whenever the action of the heart is disturbed, no system of organs is more quickly influenced by even the slightest change in the circulation than the *brain* and *spinal chord*, and the affections of the cerebro-spinal system, I will endeavour to show, afford a most important class of *symptoms* in the diseases of the heart.

Erroneous opinions of nervous diseases.

Having shown that the brain and spinal chord have not only a larger quantity of blood, more security against the supply being interrupted, more means bestowed in order to prevent irregularities in their circulation, than any other organs, we are prepared to find that certain symptoms must arise in that system when the action of the heart is disturbed. These symptoms merit the more consideration here, not only as they have not been deemed of sufficient importance by those distinguished authors who have professed to treat of the diseases of the heart, but as most of them have been arranged by nosologists as *primary* affections of the nervous system; whereas I shall endeavour to point out that many of the diseases to which the name *nervous* is usually applied are, in fact, merely symptoms of a disordered circulation. This subject, indeed, opens an extensive field of pathological research; and if the physiological views which I have endeavoured to establish in the preceding part of this work be correct, and if the pathological doctrines I am now about to point out can be clearly established, they will not only show the propriety of adopting essential nosological changes and refute some opinions which have long been very generally entertained, but they will also assist in explaining the *modus operandi* of some of those remedies which experience has found to afford relief in affections of the nervous system.

Parry's Elements of Pathology.

Whilst making these remarks, I ought not to omit alluding in a particular manner to the valuable works of Parry; and, though he did not consider that there were various morbid states of the cerebro-spinal system which arose from primary disorders of the heart itself, nor treated them as symptomatic affections of the central organ of the circulation, yet he pointed out that these nervous affections depended upon "an increased momentum of blood to the brain," and that "a large proportion of nervous affections originate in a disordered state of circulation with regard to the brain."

Influence of the blood on the nervous system.

Physiologists, I have already had occasion to remark, do not seem to have fully appreciated nor to have duly considered the powerful influence of the *blood*, and the effects which the various changes in its distribution have upon the cerebro-spinal system; for, as I have observed, whatever be the consent between the brain and the heart through the medium of nervous filaments, in a still greater degree does that relation depend upon the blood.

See page 88.

We also have seen that the various organs have each not only different quantities of blood allotted to them, but that their circulation is variously modified under different circumstances, and that they all perform their functions more or less perfectly according as they receive their proper supply of the vital element.

Diseases caused by changes in its distribution.

This influence of the blood appears no less remarkable when we contemplate the *diseases* of the different systems of the economy, a vast number of their morbid phenomena being distinctly caused by changes in the distribution as well as in the qualities of the blood.

That the circulation in the *cerebro-spinal* system should be of equal importance for the due performance of its functions, and that inequalities in the supply of its blood should be a cause of diseases in that system, in like manner as similar changes in the circulation produce them in the other systems, we are entitled to conclude, especially from the more than ordinary means that we have seen are employed by the economy to prevent the requisite supply of the vital element to the nervous system being intercepted by any of those accidental causes which more or less alter the circulation in other parts of the economy.

The protection which the vertebral arteries receive from passing to the brain through bony canals, the spinal arteries being derived from the vertebrals, the remarkable peculiarities in the arrangement and distribution of the venous system, and the large proportion of blood with which the brain and spinal chord are supplied, surely ought, when viewed collectively, to point out the greater necessity for that system having a regular supply of blood ; and, therefore, it may be inferred that, in proportion as the regularity in the supply of blood is of importance for the execution of the healthy functions of the nervous system, so any derangement in its circulation will be proportionably more injurious than irregularities in the circulation of those organs to which so uniform a supply of blood is not required.

Such, then, being the influence of the blood upon the nervous system, it is not surprising that changes in the circulation should cause a proportionate number of changes in the functions of that system ; and it is only remarkable that those who have endeavoured to investigate the diseases of the brain and spinal chord should not have taken into consideration the powerful influence of the blood, and have traced some of the maladies of the nervous system to changes in the functions of the heart.

That the nervous system is subject to various disorders from changes in the quantity of its blood is a pathological fact which has long been universally admitted. But, whilst the most incontrovertible evidence has been established that there are changes in the circulation within the head caused by disorders of the heart, it is remarkable that, until the observations of Portal, Parry, Corvisart, Laennec, and others, none of these disturbances of the cerebral circulation had ever been attributed to a primary change in the action of the heart, but to diseases in the bloodvessels of the brain itself; whereas, it would have seemed very natural for pathological inquirers to have considered how far such disturbances in the cerebral circulation might depend upon changes in the functions of the central organ of the circulation. So improbable has it appeared to some that the brain should in any way be more influenced than other organs by changes in the functions of the heart, that even one of the latest and most able writers on the subject has observed that "the blood being impelled in every direction by an impulse primarily derived from the heart, it is not easy to conceive how, in the natural state of the parts, it should be propelled to the head with greater force or in greater relative quantity than to any other part of the body." This error is to be altogether attributed to no cognizance having been ever taken of that peculiar arrangement of the cerebral arteries which I have at length explained, and by which it appears that very unusual means are employed in order at all times to provide the *cerebro-spinal* system with the proper quantity of arterial blood; whilst the remarkable peculiarities in the structure and arrangement of the veins is calculated to guard against cerebral congestion.

Abercrombie.

See p. 35.

Except in those cases where there is a local disorganization within the head, it is not easy to conceive how any change in the cerebral circulation could take place unless caused by a disturbed heart; and I cannot hesitate in believing that in those cases of apoplexy, convulsions, hysteria, and such like diseases, when they have arisen from moral causes, and of which the records of medical science afford so many instances, they have, all of them, been produced by a disordered heart.

Other causes of nervous disorders;

From what has been now said, it must not, however, be supposed that any attempt is here made to deny that various affections to which the term "nervous" has been applied by medical writers may not originate in other causes besides a disordered heart. On the contrary, in many instances the nervous symptoms can be distinctly traced to a morbid change in some portion of the cerebro-spinal system, or in some of those structures by which that system is enveloped; and likewise, in many instances, the nervous affection may be sympathetic of a derangement of the digestive or genito-urinary apparatus.

their diagnosis important.

In pursuing our investigations on this branch of semiology it is, therefore, essential to keep in view those different *causes* which may influence the functions of the nervous system; and, in every particular example of nervous disease, endeavour, by a rigorous examination into the condition of each of the different systems of the economy, to discriminate in what organ or system of organs the primary affection exists.

Causes of the different symptoms.

The symptoms which arise in the cerebro-spinal system from a disturbed circulation present considerable variety,—some being caused by an increase in the proportion of the arterial blood; some by an increase in the proportion of the venous blood; some by a diminution in the velocity of the current in the arterial blood, or in the vigour of the circulation; some by changes in the chemical qualities of the blood; and some by the admixture of the venous and arterial bloods.

Further, it may be observed that a particular assemblage of symptoms also arises either when the whole cerebro-spinal system is simultaneously affected; when one or other of the great nervous centres, or when only a portion of one of these, is disordered.

The proportion of the arterial blood increased.

Of the *first* class of these numerous symptoms, or of those which are caused by an increase in the proportion of the *arterial* blood in the cerebro-spinal system, we have examples in febrile diseases, where headache, irritability of mind, restlessness, and involuntary action of the muscles are almost constantly present, as well as some cases of apoplexy and paralysis.

The proportion of the venous blood increased.

Of the *second* class, wherein there is that assemblage of symptoms which arises from an increase in the proportion of the *venous* blood, we have examples in lethargy, stupor, and coma.

The velocity of the blood's currents diminished.

In the *third* class of symptoms, where there is a diminution in the velocity of the current of blood, the condition of the brain is characterised by a difficulty in balancing the body, reeling, vertigo, or a sensation of "swimming in the head," diminution of muscular power, and syncope; all which symptoms are exemplified in those cases of depletion where there has been a great loss of blood, or in those who have suffered from severe purging.

The admixture of the two bloods.

The *fourth* class of symptoms, those caused by a change in the *qualities* of the blood, we find examples of in chlorosis, jaundice, and in those congenital malformations and changes of structure where, from a communication between the pulmonic and systemic hearts, there is an admixture of the two bloods.

The different arteries disturbed.

In the *fifth* class of symptoms the circulation is disturbed by the current of blood being changed either in the internal carotids or in the vertebral arteries; and from the differences in the course and arrangement of these vessels we may legitimately conclude that the changes in the brain, and the symptoms arising from a disordered arterial circulation, will necessarily differ according as these changes are caused by a disturbance in one or other of these great arterial trunks.

The different portions of the cerebral system affected.

In the *sixth* class of symptoms, and where only a portion of the cerebral system is affected, those parts of the brain which execute the intellectual functions are influenced singly or in combination when the action of the heart is even temporarily disturbed, and hence arise all those symptoms, such as irritability, passion, and even mental aberration, and the various shades of intellectual energy.

The same observation applies to other portions, or other [illegible] being affected [illegible] particular portions of the cerebrum.

The particular nerves and [illegible] distributed [illegible] the heart, especially [illegible] and the various forms of cardiac [illegible].

It [illegible] strange that the different portions of the nervous system should be thus affected [illegible] especially [illegible] which of the system, I suppose, will [illegible] from the [illegible] remarkable [illegible] phenomena [illegible] in the disease of other [illegible] as well as in the effects of many medicinal substances.

We have no [illegible] the [illegible] of the [illegible] supply to the stomach and the kidneys [illegible] their respective organs [illegible] circulation [illegible] in such a manner as to enable them to execute their particular functions.

No doubt it must be so as regards the vascular distribution of the different portions of the nervous system, the functions of each of these being quite different, and each requiring a different vascular distribution, and consequently each portion may be diseased separately.

And as regards the influence of medicinal substances on the nervous system we are not more familiar with any phenomenon than the effect of particular substances on particular portions of that system through the medium of the blood, such as the influence of belladonna on the iris, of strychnine on the motor and of chloroform on the sensory columns of the spinal chord.

That the spinal chord may be affected in a similar manner as the brain by changes in the circulation and thus afford us a very important class of symptoms in diseases of the heart may be understood from the interesting and no less important anatomical fact to which I have formerly alluded,—that the whole cerebro-spinal system is supplied with blood from the same channels, and, therefore, whatever causes any alteration in the circulation of the brain must have a like influence on the circulation of the blood in the spinal chord.

Relation of the spinal chord and heart

And if the opinion of Gallois be sustained, that the heart derives its chief motion from the spinal nerves, we are naturally led to expect that, when the heart is disordered, a wider range of morbid changes will be produced in the functions of the spinal chord than in those even of the brain itself. Comparative anatomy, which contributes so much to illustrate physiological inquiries, seems to strengthen this opinion, Clift having found that "the muscles of the body of a *carp* can be thrown into powerful action four hours after the brain and heart have been destroyed; but the moment the spinal marrow was destroyed the muscles lost all power of action."

Illustrated by comparative anatomy.

Phil. Trans., 1815.

Five classes of symptoms derived from the spinal chord.

The spinal chord, besides being liable to be influenced by all those changes in the circulation which disturb the functions of the brain, has, too, like the brain, particular *portions* only affected in different diseases of the heart, and all these changes in the spinal chord afford also an important addition to our catalogue of symptoms in the heart's diseases.

The first class.

The *first* class of these symptoms will be found to arise from the *motor* column being affected, causing involuntary actions of the muscles which it supplies, or producing a diminished power of these muscles; and in either case only one, or a larger number of the motor nerves, may be affected.

The second class.

A *second* class of symptoms is caused by a change in the *sensory* column, and in these there may be either an increase or a diminution of sensation, and the whole, or only one nerve of that column, may be affected.

The third class.

In a *third* class one or more nervous trunks both of the motor and sensory columns are affected at the same time.

The fourth class.

In a *fourth* class the motor column of one side only, and the sensory column of the other side, of the body are affected.

The fifth class.

And in a *fifth* class not only both columns of the chord, but, likewise, the cerebral functions are deranged; and, as before remarked, these changes take place, in some instances, to such a degree, that nothing appears to exist but organic life.

Of all the different symptoms derived from the spinal chord, and of their various combinations, we have abundant examples in those cases of apoplexy, palsy, convulsions, hysteria, epilepsy, catalepsy, chorea, tetanus, and syncope, wherein the primary disease is seated in the heart.

Sir Charles Bell's discoveries.

These pathological phenomena, to which I have alluded, afford a beautiful illustration of the important discoveries of Bell; and, indeed, the investigations of that eminent physiologist, taken conjointly with the views which I have given of the circulation in the cerebro-spinal system, will, I am persuaded, essentially contribute to explain many pathological conditions of that system of the economy; and it appears to me by no means unreasonable to anticipate that we may be ultimately able to refer affections of the different roots of the nerves, and of particular portions of the brain, each to some corresponding morbid condition of the heart; and, also, that we shall be able to explain how one person with a disordered heart should complain of ringing in the ear, another of false images before his eye, another of vertigo, another of convulsions, another of neuralgic pains, and another of loss of sensation.

Symptoms derived from the ganglionic system.

As the heart is supplied with nerves chiefly from the *ganglionic* system, it might be anticipated that, in the diseases of the heart, the different organs which are supplied by that nervous system will be more or less influenced.

Hence arises the sympathetic affections of the stomach and other abdominal viscera, and likewise some of those disturbances in respiration which frequently accompany diseases of the heart—affections all of which will be found to afford important symptoms in the semiology of this organ.

The particular symptoms considered.

Thus far I have endeavoured to give a general view of the various symptoms which are manifested in the nervous system when the functions of the heart are disturbed. In prosecuting our investigations we are now led to examine more in detail some of the most prominent of these symptoms; and in order to facilitate this inquiry a *table* is annexed, in which the symptoms are enumerated; and, to preserve some order, those are first mentioned which appear to influence the whole nervous system, then such as chiefly affect the brain and the nerves emanating from it, and afterwards those more especially which are derived from the spinal chord, being, at the same time, quite aware that such an arrangement is merely arbitrary, for, as in all our investigations on this subject, it is requisite ever to keep in mind the unity of the whole cerebro-spinal system in its diseased as well as in its healthy state.

TABLE

OF THE SYMPTOMS DERIVED FROM THE CEREBRO-SPINAL SYSTEM.

Watchfulness—*insomnia.*
Somnolency—*sopor.*
Coma.
Fainting—*syncope.*
Dreaming—sleep-walking, sleep-talking, nightmare.
Headache.
Mental irritability.
Mental aberration.
Giddiness—*vertigo.*
Ringing in the ear—*tinnitus aurium.*
Ocular spectra—*musci volitantes.*
Neuralgia.
Angina.
Palsy—*hemiplegia, paraplegia.*
Apoplexy.
Epilepsy.
Catalepsy.
Hysteria.
Convulsions—*chorea, subsultus, tremors.*

Watchfulness. See p. 89.

Insomnolence.—Having pointed out how sleep and wakefulness depend upon the alternate diminution and increase of the vigour of the circulation, we naturally anticipate that these two conditions of the system will vary according to the state of the central organ, and hence irregularities in sleep and waking may be considered as *symptoms* in diseases of the heart.

Insomnia.

In disturbances of the heart we find that sleep is changed either in duration, or it is unnatural and imperfect slumber.

Insomnolence, or watchfulness, may be considered as one of the most usual deviations from natural sleep, and it is one of the most distressing symptoms which often accompany a disordered heart. Like food, the quantity of sleep which is required it is difficult to measure, and be thus able to point out when watchfulness may be considered as a symptom of disease; for it is of very different duration in different individuals, and even in the same person at different times; and we never sleep twice precisely in the same manner.

It is marvellous to what extent the maniac will remain in a waking state without any apparent injury.

Good, in the Medico-Chirurgical Transactions.

A man never slept, and yet he enjoyed good health, living till his seventy-third year. He had a kind of *dozing* for about a quarter of an hour once a day, which was all the slumber he was ever known to take.

Every one is familiar with the effect of too great mental excitement, immediately before the usual hour of rest, in causing watchfulness; such excitement producing an inordinate action of the heart, and the increased action of the heart increasing the quantity of arterial blood in the brain.

Those afflicted with a disturbance of the heart suffer various imperfections of sleep. When in a profound sleep they sometimes start up in bed, completely awake, and are obliged to remain in the erect position in order to relieve a sense of impending dissolution. They are also subject to frightful dreams; and in other cases their sleep is of too long duration, and they are awoke with difficulty.

Headache.—Pain, uneasiness, weight, tightness, throbbing, swimming, giddiness, are all sensations in the head which are experienced by those who are suffering from a disordered heart; and these different feelings are found to be present in two very opposite conditions of the brain—the one produced from an increase, and the other from a decrease, in the vigour of the circulation.

Headache from increase of arterial blood;

There are no pains in the head more frequent than those which are the effect of that increased action of the central organ of the circulation which takes place during febrile diseases and from violent mental emotions. " In many fevers the symptoms are kindled up in the brain, which points out an increased action of the heart. There is not only headache, but all the perceptive powers become preternaturally acute. The patient hears the sound of the approaching carriage, or of the distant nightingale, while to those who surround him everything is clothed in darkness and silence; ideas pass through the mind with such velocity that the apparent period of a month is comprised within the limits of a day, and the patient is conscious of a corresponding rapidity of utterance which he feels himself with difficulty able to control." (Parry.)

Headache, too, often accompanies those temporary increased actions of the heart which are produced by overheated rooms and crowded apartments, the headache in such cases being caused by an increased quantity of the systemic blood within the head.

And the headache which comes on when a person has been suddenly awoke out of a profound sleep marks also a change in the circulation. The action of the heart is then increased, and the consequence of such inordinate action is, that an additional quantity of arterial blood passes into the brain. The uneasiness in the head in such cases usually continues until the general circulation is tranquillised by a renewal of sleep, or by an additional quantity of arterial blood being directed to the stomach from the presence of some food, by which the quantity of arterial blood in the brain suffers a corresponding diminution.

from a diminution of arterial blood.

No less severe is that headache which follows large depletions, and which, being caused by a diminished supply of arterial blood in the brain, is relieved by those means that are known to increase the vigour of the heart's action, such as ammonia, camphor, and wine.

These headaches, whether caused by an increase or by a diminution of the arterial blood in the head, are of a very different character from those feelings caused by an increase in the proportion of the venous blood, and which are characterised by more or less lethargy and stupor.

Vertigo.

Giddiness.—There is a particular class of sensations in the head, which are different from those already mentioned, that are also important symptoms in disorders of the heart. The sensations to which I allude are a dizziness, reeling, or swimming in the head, especially a want of power to balance the body, sensations which come on suddenly, continue only for a short time, often create much alarm, and all which are caused by a *diminished* supply of arterial blood to the brain.

Such feelings are very different from those caused by an increased quantity of arterial blood, from a congestion of venous blood, or from the uneasy feelings or pains in the head which are symptomatic of a derangement in the digestive organs, although these various conditions of the cerebral circulation are apt to be confounded with each other.

Difficulty in balancing the body.

There is no symptom which may be considered more pathognomonic of a disturbed heart than a difficulty in balancing the body when the person attempts to walk, or change suddenly from the horizontal to the erect posture. Hence many of those afflicted with a disorder of the heart occasionally find it necessary to catch hold of some fixed point in order to prevent themselves from stumbling. "We totter when we get up, and if we lay hold of anything the hand lacks its wonted strength." Macnish.

Mental Irritability and Aberration.—There is no more frequent symptom of a disordered heart than mental *irritability*, though in some instances it may be difficult to trace whether the irritable state of the mind is caused by a disturbed heart, or the disturbance of the heart is the effect of an irritable mind. I am disposed to believe that, in the great majority of such cases, the state of the intellectual faculties depends entirely upon the condition of the heart, and, therefore, that the disordered state of the nervous system may be taken as an index or sign of some change in the function of the central organ of the circulation, especially in those cases where the disturbed state of the nervous system is accompanied with other well-established diagnostic symptoms of a disordered heart.

The nervous temperament explained.

See p. 121.

The *nervous temperament*, commonly so called, appears to depend, I have remarked, either on an unusually excitable nervous system, or upon an irritable or easily excited heart; for the same class of symptoms will arise, whether the brain excite the heart, or the heart excite the brain; and both these conditions may be combined in the same individual.

An irritable state of mind, like headache, may be caused either by an increase or by a diminution in the proportion of the arterial blood within the head. When the action of the heart is increased by violent passions, there is a corresponding increase in the flow of arterial blood to the head, and the mind becomes more or less irritable, impatient, and unable to be employed in its usual avocations. On the other hand, an irritable condition of the mind, from a diminution of arterial blood within the head, often follows depletion or exhaustion—a state which is relieved by sleep, food, or cardiacs properly so called.

Mental depression.

There is a very peculiar state of mind in those suffering from disorders of the heart, and which, as far as my own observation goes, may be considered pathognomonic of an affection of this organ. In the condition of the mind to which I allude the sufferer has a fearful *apprehension of evil*, being harassed with the most painful and distressing emotions, giving to the countenance that peculiar expression the *facies propria* so frequently to be remarked in those afflicted with disease of the heart.

This disquietude of mind is very different from mental irritability, or common "depression of spirits," and those who are afflicted with it, whatever be their natural disposition and moral and physical courage, all describe their sufferings to be a sense of impending death, and which is accompanied with a most alarming apprehension of that event. This state of mind varies in degree; but, as a general remark, I may observe that all those whose circulation is disturbed suffer more or less from what are usually called *nervous* symptoms, the term nervous being used figuratively, and applied to their moral condition.

Case.

An officer, distinguished in the field of battle, suffered from congestion of the heart, which had been caused by a domestic affliction. When, from any temporary excitement, the circulation was suddenly disturbed, he was attacked with uneasy sensations of fulness, and what he called "spasms in the chest," and these were accompanied with a painful apprehension of death; but at other times, when free from these spasms, he felt his courage unsubdued.

Thompson. Case.

A nurse, who had a disordered heart from long watching, and whose sleep had often been interrupted, complained of a sensation of fulness, and of uneasy feelings in the chest, and frequently apprehended sudden death. "I cannot understand," she said, "how it should be that on these occasions I have such a terror of dying, for my general state of mind, when in health, is, instead of fearing death, having rather a wish to die."

This state of mind forms a striking contrast to that of persons who, in the last stages of pulmonary phthisis, so frequently augur with perfect confidence of their recovery; and also to those who suffer a depression of spirits caused by dyspepsia and disorders of the digestive apparatus, by whom death is often looked forward to even with hope; and to those likewise who have affections of the head of an inflammatory character, in whom there is usually a state of mind that disposes them either to injure themselves or those around them.

Mental aberration.

The influence of the heart upon the brain opens an interesting field of research to those who are employed in the investigation of the diseases of the mind; and I am convinced that, in many cases of insanity, the primary cause of the condition of the brain will be found seated in the heart, more especially in those examples of mental aberration where the heart has been "broken" from mental affliction, and examples of which history abounds with.

Illustrated by their treatment.

Such cases of lunacy will be found to have, indeed, a very different character from those which are caused by a morbid condition of the brain or its membranes; and it is scarcely necessary to remark that the system of treatment calculated to remedy the one class of cases is not applicable to the other. It is in most instances of the first description wherein the success of certain remedies employed in the treatment of the insane chiefly depends; such as the various modes of gestation, swinging, and rotatory movements, nausea and vomiting, all which must relieve the sensorium by the effects they have in diminishing the vigour of the circulation. So, likewise, with regard to the use of tartrate of antimony and hellebore, both of which act upon the heart. Page 137. Hellebore, which I have already mentioned has been employed to simulate disease of the heart, was, by the ancients, considered almost a specific for the cure of insanity.

Dreaming.—As it has been pointed out, that during perfect sleep there is a suspension of all the cerebral functions, Page 92. so we find that there is a series of imperfections of sleep, each of which is caused by one or more of the cerebral organs being awake. It is the waking state of some one or other of the cerebral organs or isolated portions of the brain which is the cause of dreaming, somnambulism, sleep-talking, and nightmare; and hence may the various kinds of dreaming be considered as *symptoms* of a disordered circulation.

The changes in the condition of the spinal chord during disturbed sleep are similar to those which take place in the brain; for whilst the functions of all the spinal nerves, except those of organic life, are completely arrested during perfect sleep, some of them, when the slumber is less perfect, remain active; a condition of that system which is remarkable in somnambulism, in which the organs of active motion are especially excited. "Sometimes certain involuntary motions are combined with dreaming, so that the organs of speech, and many or all of the limbs, are directed by these perceptions, as in sleep-talking and somnambulism." Haller.

In these respects there appears to be a strict analogy between *sleep* and *wakefulness*, for all the cerebral organs are not equally active when we are awake, and some functions are altogether suspended. "We have even a power within ourselves to be insensible to impressions on certain organs under particular circumstances," as is often exemplified in Bichat. those of hearing and sight; loud sounds, or sounds we are accustomed to perceive, or the most interesting objects passing by unobserved, when other organs are in a state of great excitement.

It is by the exercise of this power that the most beneficial results are derived by those who are exposed to much mental exertion. The mind, like the body, has not only its alternate seasons of activity and repose, but, by that faculty which I have now mentioned, when one of the cerebral functions has been fatigued, occupying the mind in some other pursuit, the cerebral organ which had been exhausted then becomes refreshed and again able, if called upon, vigorously to perform its functions.

In many febrile diseases, when the action of the heart is much changed, "sleep becomes almost wholly wanting, or is very imperfect. The patient, for a while, forgets the surrounding objects; horrid images present themselves to his sight, so exactly mocking realities, that he starts out of his sleep violently agitated, and for a while hardly believes that he was in a dream." Parry, p. 231.

Somnolency.—Contrasted with watchfulness are somnolency, coma, catalepsy, and syncope,—all conditions of the cerebro-spinal system indicating a *diminution* in the vigour of the heart.

Somnolency may be considered a modification of sleep, or a deviation from the healthy state of that function; and in the same manner as an increase in the proportion of the arterial blood causes wakefulness, so in somnolence or lethargy there is an increase in the proportion of the *venous* blood in the cerebro-spinal system; the first of these conditions of the brain being diagnostic of disease of the systemic, and the second pointing out some disturbance in the pulmonic, heart.

Case. A man, about the middle period of life, suffered from a disease of the right heart, which ultimately caused his death. He would, at times, during the latter months of his illness, remain for several days in a state of lethargy, and, in the intermediate times, his intellectual powers were restored.

"The sleeping girl of Montrose." "A girl, eighteen years of age, after having suffered three weeks from a nervous fever, awoke one morning with a profuse bleeding from the nose, which continued for several hours. The loss of blood must have been considerable, but the exact quantity could not be ascertained. Immediately after this took place, she fell into a comatose state, and, two days after, she was conveyed to her father's house, and remained fifteen hours there in the same state. She then awoke and took some food, complaining only of weakness.

"About fifteen hours afterwards she again became comatose, and continued in that state seven days and seven hours, without taking any kind of nourishment, and without the evacuation of either fæces or urine. After this period some food was given, by putting the patient's hand with a spoon to her mouth, and pouring it in, by which she was enabled to swallow, although still comatose; but the hand remained in the same situation till put back by the assistant. In this state she continued thirty days more, receiving nourishment in the same manner occasionally, and passing her fæces and urine involuntarily.

On the thirtieth day some signs of hearing were evident, and about half-past ten at night she was lifted from her bed, and in the course of a few minutes all her faculties returned."

Edinburgh Medical and Surgical Journal.

Coma—its nature.

Coma.—This state of the sensorium is so nearly allied to somnolency that they may be considered as the continuous links of a chain, being in all probability only different degrees of the same pathological conditions of the cerebro-spinal system, and in which condition the functions of the heart are so impaired that the whole nervous system appears to be wanting in its due supply of arterial blood, and consequently all the functions of both animal and organic life to have become more or less enfeebled.

Causes of coma.

A comatose state may be produced either by physical or by moral causes. It may be caused from the heart not being able to propel the blood either in consequence of morbid changes in its structure, from a want of sufficient muscular power; from a diminution in the quantity, or from a change in the quality, of the vital fluid; in all which cases it is "sometimes accompanied by convulsions or spasms, at other times with a delirium alternating with convulsions."

Parry.

Fear and sudden grief are a frequent cause of coma, in these cases the mental excitement producing a congestion of blood within the heart.

If we can suppose a state of the heart where there is already within its cavities too much blood, any convulsive movement, in place of relieving such congestion, would inevitably increase it and aggravate the symptoms.

Accordingly we find that, whenever the heart is congested to such a degree that it is incapable of emptying itself sufficiently, there comes on, in place of syncope and convulsions, a state of coma, and which in some instances continues an extraordinary length of time, the circulation being only vigorous enough to preserve organic life, until, finally, the general mass of blood is so greatly diminished, becomes so imperfect from the enfeebled state of respiration and from not receiving the requisite supply of chyle, that the heart is sooner or later enabled to perform its functions more vigorously, the cause of the retarded circulation being thus gradually removed, and ultimately the sufferer awakes in a state of comparative health.

In some instances the congestion of the heart and the comatose state which accompanies it take place to such a degree as even to destroy life; and, as I have observed when speaking of the influence of the mind upon the heart, in those instances where persons have expired from sudden grief their death has been caused by cardiac congestion.

See page 126.

A long-protracted comatose state may not be unaptly compared to *hibernation* in animals; and, if only such a state could be artificially produced in man, many of his ailments might thus be mitigated, especially those of the circulating and nervous systems. Indeed, I am convinced that the prolonged state of *syncope* and great inanition which often supervenes excessive hemorrhages is sometimes the means of curing the diseases by which they have been caused.

Apoplexia cataleptica.

Catalepsy appears to be nearly allied to coma, and of all the imperfections of sleep it approaches nearest to death; for during the cataleptic paroxysm not only the whole of animal life ceases, but organic life can scarcely be said to exist.

Of the precise nature of catalepsy little is understood, but it appears to me that the most remarkable symptoms of that state are referable to changes of the circulation in the cerebro-spinal system, and that these usually depend upon changes in the condition of the heart.

Fainting.

Syncope.—Whenever there is any impediment to the free egress of the arterial blood from the left heart, or when a large quantity of the general mass of blood has been abstracted from the system, the supply of the vital fluid to the brain being then diminished, there follows languor, loss of sense, voluntary motion, and *syncope*.

Most of the morbid changes in the left heart must, it is evident, produce a diminished impetus in the current of the systemic blood by the imperfect manner in which such structural changes cause the heart to propel the blood into the large arterial trunks.

But, in diseases of the heart, besides that series of symptoms which arises from a diminished supply of arterial blood to the cerebro-spinal system, there may be symptoms produced by the *venous* blood not having its free ingress from the *venæ cavæ* and its egress into the pulmonary artery from the right heart; and these causes of a languid circulation will happen whether the structure of the valvular apparatus of either heart be injured, or their parietes be, from any structural change, unable to propel the blood with its wonted vigour.

Syncope varies exceedingly, both in degree and in duration, in maladies of the heart. Sometimes it characterises a mere temporary disturbance in the heart's action, of which we frequently see examples in hysterical women. In many instances of syncope the beatings of the heart and arterial pulse can scarcely be perceived, life appearing extinguished; and many of those who die from cardiac disease expire in consequence of the paroxysm of that syncope to which they may have long been subject continuing beyond a certain time, and far as I know, has attempted to give any explanation of those peculiar arrangements of the vascular system by which so important a relation between the nervous system and the heart is established; and even one of the latest writers on this subject observes: — "There is reason to believe that certain apoplectic affections are connected with a disease of the heart, *the nature of which is extremely obscure.*"

But now that the peculiarities of the circulation in the brain have been shown to be so completely dependent on the heart's action, and the relation of the brain and heart entirely depending on the blood, the pathological phenomena of the two vital organs can, I think, be very satisfactorily explained.

The symptoms which accompany these conditions of the brain, the idiopathic and the symptomatic, though some symptoms may be common to both, yet each assemblage, taken collectively, must be of a very different character; for it is reasonable to surmise that the symptoms of a disorganisation of the brain, or of its meninges, cannot have the same influence upon the economy as those changes in the circulation within the head which are caused by a disordered heart.

Of the first class of symptoms, or of those arising from an idiopathic affection of the cerebro-spinal system, I am not now to discuss, but will endeavour to investigate only those which are developed in that system when the heart's functions are disturbed; symptoms which have never been enumerated and classed together as appertaining to the semiology of the heart.

Such symptoms, I think it will appear, must necessarily be of two kinds: one caused by changes in the *systemic*, and the other by changes in the *pulmonic*, heart; and this view of the nature of the different kinds of apoplectic fits, simple as it may appear, yet enables a satisfactory explanation to be given of the various and apparently incongruous assemblage of symptoms of these diseases which have been classed together by nosologists, and will also account for the inconsistent subdivisions and number of species which they have enumerated.*

For it is clear that, as one part of that history includes certain symptoms caused by a change in the circulation of the *venous* blood within the head, another enumerates a series of symptoms produced by a change in the circulation of the *arterial* blood: two perfectly distinct conditions of the nervous system, and thus confounded with one another.

Apoplexy may be either venous or arterial.

That one state of the cerebral circulation produced by a disorder of the *right* heart, and another by a disorder of the *left*, may either of them cause apoplexy, can be clearly demonstrated by the differences of the symptoms in the two kinds of the disease, so that according to the character of these symptoms will the seat of the disease in the particular heart be indicated.

And an important induction from this view of the pathology of apoplexy is, that the general system of treatment ought to be entirely different in the two forms of the disease; whilst it likewise affords a satisfactory explanation of the remarkable discrepancy in the principles of treatment which have been generally recommended.

At the same time that such a distinct line of demarcation can be legitimately drawn between an *arterial* and a *venous* apoplexy, it must not be denied that examples may be found where these two states of the vascular system are combined, both existing at the same time.

Analogy of apoplexy, &c.

Confirmatory of the preceding views, I may observe that the condition of the vascular system of the brain in apoplexy appears to bear a very strong analogy to an inflamed organ caused by the heart not then being able to overcome some mechanical obstruction to the circulation.

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* TABLE

OF THE DIFFERENT SPECIES OF APOPLEXY.

APOPLEXIA

Sanguinea,
Serosa,
Simplex,
Inflammatoria,
Plethorica,
Arthritica,
Rheumatica,
Catarhalis,
Hereditaria,
Spasmodica,
Convulsiva,
Hysterica,
Nervosa,
Fulminans.

Though, when protracted beyond a limited period, it may prove fatal, yet syncope sometimes continues such a length of time, that the condition of the heart producing the fainting state is apparently relieved by it.

Syncope I have pointed out to be one of those acts which Nature herself resorts to for relieving certain disturbances of the circulation, and which is so successfully employed artificially in order to effect a similar purpose; and, as the state of syncope has so powerful an influence in mitigating some disorders of the heart, if we had any safe mode of keeping a person in a prolonged state of fainting, we might, perhaps, be able to remedy many diseases, depending upon an altered condition of the circulating system, which are at present considered beyond the reach of art.

Gazette Médicale.

To effect this purpose it has always appeared to me that the ingenious "cupping boots," invented by Junod, might be advantageously employed. Abstracting by means of that instrument a quantity of blood from the trunk of the body to the extremities sufficient to cause fainting, that state might be produced in any degree, and prolonged any length of time, so that a powerful effect upon the heart might be thus produced.

Apoplexy.—Pursuing our inquiries regarding those symptoms in diseases of the heart which are derived from the influence of changes in the circulation on the cerebro-spinal system, we come next to consider the nature of the different kinds of *fits* or paroxysms which have been enumerated in systems of nosology, such as apoplexy, epilepsy, hysteria, convulsions, and palsy—all of which depend either upon some idiopathic affection of the cerebro-spinal system, or they are *symptomatic* of some primary affection of the heart, and "agreeing with each other only in their final influence upon the functions of the brain." Abercromby.

However much the different kinds of fits may resemble one another, yet attempts have been made to draw a distinct line of demarcation between each; but if we examine minutely and compare the symptoms which are manifested in each species, although the general assemblage of the symptoms may be different, there is no one symptom that does not sometimes occur in examples of all of them.

In the different kinds of fits are to be found every possible combination of changes, both in the functions of the brain and spinal chord, affording examples of all those classes of symptoms which have been enumerated; at the same time the portions of the cerebral system which are affected in particular disorders of the heart, pathological research has not yet revealed; and all the evidence we possess on this subject goes only to prove that certain changes do take place in the functions of the nervous system from changes in the functions of the heart.

See page 153.

The descriptions given of apoplexy in particular, and the various *species* of that disease which nosologists have enumerated, offer a striking proof of the error of grouping together those diseased conditions of the nervous system which may be the effect either of some primary disorganisation of the brain and its surrounding structures, or, what I believe to be far more frequent, of diseases of the cerebro-spinal system arising from the circulation in the head being disturbed, in consequence of a disorder of the heart.

By the older writers an apoplectic fit had always been considered to be the effect of some mechanical *compression* upon the brain; but pathologists were long before they suspected that the cause of such compression was commonly to be found in a heart whose functions were disordered. In fine, until the works of Portal, Corvisart, and Laennec appeared, it seems never to have even been conjectured that changes in the cerebral circulation could depend upon or arise from changes in the functions of the central organ itself; and although the coexistence of an apoplectic fit with a diseased heart, in a large proportion of cases, has since been universally admitted, still no one, as far as I know, has attempted to give any explanation of those peculiar arrangements of the vascular system by which so important a relation between the nervous system and the heart is established; and even one of the latest writers on this subject observes: — "There is reason to believe that certain apoplectic affections are connected with a disease of the heart, *the nature of which is extremely obscure.*" Abercromby.

But now that the peculiarities of the circulation in the brain have been shown to be so completely dependent on the heart's action, and the relation of the brain and heart entirely depending on the blood, the pathological phenomena of the two vital organs can, I think, be very satisfactorily explained.

Symptoms of the two classes differ.

The symptoms which accompany these conditions of the brain, the idiopathic and the symptomatic, though some symptoms may be common to both, yet each assemblage, taken collectively, must be of a very different character; for it is reasonable to surmise that the symptoms of a disorganisation of the brain, or of its meninges, cannot have the same influence upon the economy as those changes in the circulation within the head which are caused by a disordered heart.

Of the first class of symptoms, or of those arising from an idiopathic affection of the cerebro-spinal system, I am not now to discuss, but will endeavour to investigate only those which are developed in that system when the heart's functions are disturbed; symptoms which have never been enumerated and classed together as appertaining to the semiology of the heart.

Those symptoms caused by a diseased heart.

Such symptoms, I think it will appear, must necessarily be of two kinds: one caused by changes in the *systemic*, and the other by changes in the *pulmonic*, heart; and this view of the nature of the different kinds of apoplectic fits, simple as it may appear, yet enables a satisfactory explanation to be given of the various and apparently incongruous assemblage of symptoms of these diseases which have been classed together by nosologists, and will also account for the inconsistent subdivisions and number of species which they have enumerated.*

For it is clear that, as one part of that history includes certain symptoms caused by a change in the circulation of the *venous* blood within the head, another enumerates a series of symptoms produced by a change in the circulation of the *arterial* blood: two perfectly distinct conditions of the nervous system, and thus confounded with one another.

Apoplexy may be either venous or arterial.

That one state of the cerebral circulation produced by a disorder of the *right* heart, and another by a disorder of the *left*, may either of them cause apoplexy, can be clearly demonstrated by the differences of the symptoms in the two kinds of the disease, so that according to the character of these symptoms will the seat of the disease in the particular heart be indicated.

And an important induction from this view of the pathology of apoplexy is, that the general system of treatment ought to be entirely different in the two forms of the disease; whilst it likewise affords a satisfactory explanation of the remarkable discrepancy in the principles of treatment which have been generally recommended.

At the same time that such a distinct line of demarcation can be legitimately drawn between an *arterial* and a *venous* apoplexy, it must not be denied that examples may be found where these two states of the vascular system are combined, both existing at the same time.

Analogy of apoplexy, &c.

Confirmatory of the preceding views, I may observe that the condition of the vascular system of the brain in apoplexy appears to bear a very strong analogy to an inflamed organ during the acute and chronic stages of inflammation. As in *arterial* apoplexy there is an increased quantity of arterial blood in the brain, so during the *acute* stage of inflammation there is an increase of the arterial blood in the inflamed part; and likewise, as in the *venous* apoplexy, where there is an increased proportion of venous blood within the head, so in *chronic* inflammation the venous system of the part affected has become congested, and the arterial circulation so languid, that the diseased organ appears to be congested entirely with venous blood.

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* TABLE

OF THE DIFFERENT SPECIES OF APOPLEXY.

APOPLEXIA

Sanguinea,
Serosa,
Simplex,
Inflammatoria,
Plethorica,
Arthritica,
Rheumatica,

Catarhalis,
Hereditaria,
Spasmodica,
Convulsiva,
Hysterica,
Nervosa,
Fulminans.

This analogy may be traced still further by comparing the most appropriate systems for the treatment of the two forms of apoplexy with those which are employed for inflammation in its two opposite stages.

In acute inflammation, as in *arterial* apoplexy, a depletive treatment is equally applicable; whereas, when the inflammation is passive, evacuating remedies, as in *venous* apoplexy, afford comparatively but little relief, stimulants being in both cases efficacious.

Venous apoplexy.

Reviewing the different accounts that have been given of the nature of apoplexy, it will be found that some histories of the disease dwell more especially upon those symptoms which mark the disturbed state of the *venous* circulation, or of a disorder in the *right* heart. The diminished vigour of the intellectual powers, the disposition to sleep, and lethargy, the livid and turgid countenance from over-distention of the subcutaneous veins, the embarrassed respiration, the slow and easily compressed pulse, are all symptoms caused by a disturbance in the circulation of the *venous* system.

Arterial apoplexy.

Whereas, in those cases of apoplexy in which the condition of the sensorium is altered from an increased proportion of the *arterial* blood, there is giddiness, headache, vertigo, ringing in the ears, ocular spectra, insomnolency, mental irritability, flushed countenance, along with a vigorous action of the heart, and a full, throbbing arterial pulse, symptoms all of which indicate a disorder of the left heart.

This account of the nature of apoplexy, and of the two

Different systems of treatment explained.

distinct and very different conditions of the cerebro-spinal circulation in each type of that affection, not only affords a most useful contribution to the catalogue of *symptoms* in the diseases of both hearts, but, as I have already said, it reconciles the contradictory accounts which have been given of the history of the symptoms; and more especially explains the apparent inconsistency in the different modes which have been recommended for treating apoplexy. I refer to the one system of treatment, which consists in the use of *depletive* means, and to the other, wherein the propriety of exhibiting *stimuli* is advocated. To affections of the systemic heart the depletive system of treatment is undoubtedly applicable; but, where the pulmonic heart is gorged with blood, the depletive system is equally objectionable, as, by still further reducing the vital powers, the venous congestion will be increased; whereas the exhibition of stimuli or *cardiacs*, properly so called, by invigorating the heart, will enable it the better to propel the blood into the arterial system. At all events, the effects of opening the temporal artery or the jugular vein, both of which have their advocates, must be very different in the two forms of this disease; for whilst in venous apoplexy abstracting a certain quantity of venous blood might relieve the right heart and the venous congestion in the head, the abstraction of arterial blood would diminish the vigour of the heart, and, by rendering the arterial stream in the head less vigorous, the congestion of the venous system would not be diminished.

See p. 165.

The abstraction of a certain quantity of blood, I have said, may relieve congestion of the right heart. Experiments on animals have distinctly shown how, when the pulmonic heart has become so congested that it ceases to beat, its pulsations are immediately restored by venesection; so that the abstraction of a limited quantity of blood in *venous* apoplexy will enable the heart to propel its contents with more force; the quantity of the vital element, however, which is abstracted ought to be so moderate that the vigour of the circulation shall not be diminished.

See Appendix L.

Hysteria.

Hysteria. — What has now been said of the nature of apoplexy is, in many respects, applicable to other fits, especially to those of *hysteria, epilepsy*, and *convulsions*, all of which may be considered as "different links of one chain, caused by changes in the circulation of the blood within the head;" and which changes in the circulation of the cerebro-spinal system I shall also endeavour to show are, at least in many instances, caused by a primary affection of the heart, and may, therefore, be added to the catalogue of *symptoms* of a disordered heart.

See Appendix.

Considered as one of the neuroses.

The pathology of *hysteria* has never been very clearly explained, and nosological writers have been satisfied with arranging it amongst *nervous* diseases, though it may, I think, be distinctly shown to be most commonly symptomatic of an affection of the heart; the various symptoms which characterise it being all referable to changes in the distribution of the blood in the cerebro-spinal system, and the hysteric paroxysm being always preceded or accompanied by palpitations more or less violent.

Amongst the more striking symptoms of hysteria may be enumerated palpitation of the heart, dyspnœa, involuntary movements of the muscles, temporary disturbance of the intellectual powers, screaming, sighing, sobbing, weeping, laughing, all these being instinctive acts of the economy, as I formerly pointed out, which are employed by the *vis conservatrix* to restore a disturbed circulation.

See p. 71.

The causes, too, which produce hysteria afford another channel of evidence to prove that the primary affection is often seated in the heart. Mental emotions, and these in persons of an irritable and easily excited temperament, are the most common causes of an hysteric paroxysm.

There is still another and no less important source of evidence that the heart is the organ which is often primarily affected in hysteria, afforded by the class of medicines which are successfully employed for the treatment of hysterical affections, all these being such as are well known to act upon the organs of circulation—such as antimony, iron, copper, zinc, and all the antispasmodics commonly so called.

Epilepsy, likewise, is by no means an uncommon symptom in those affected with a disorder of the heart, and the circumstance of a person being subject to epileptic fits points out the propriety of examining the condition of the heart, in order to ascertain how far the fit depends on a disturbed circulation, and not upon any primary disease of the encephalon, or symptomatic of some disease of the abdominal viscera. "I have seen," observes Parry, "several instances in which epileptic fits immediately followed violent palpitation of the heart, which, in one of the cases, was excited by merely a disagreeable smell, and produced the paroxysm in a patient who was never previously so affected. It may, indeed, with great reason be doubted whether palpitation be not a prelude to the fit in most cases, although in many the approach of the paroxysm is so rapid that the true series of symptoms elude or escape observation." Epilepsy.

I may here, too, remark, that the cases of epilepsy, like those of hysteria, which are under the influence of medical treatment, have usually been relieved by such remedies as act upon the circulation, and of which I might quote many examples.

The convulsive movements which accompany the epileptic as well as the hysteric paroxysm must have the effect of assisting in restoring the circulation, which in these affections is so manifestly deranged; for, as I have shown that in all disorders of the heart where convulsive movements take place, as these movments must increase the quantity of blood in the left ventricle, so it may be expected that it will only be in those conditions of the heart where there is a want of systemic blood that convulsions will take place spontaneously, and as a restorative or curative act of the economy.

Convulsions.—Of that class of symptoms in diseases of the heart derived from the spinal chord in which only the nerves of the *motor* column are affected, the most remarkable are convulsions; and these take place occasionally in all the various kinds of fits, and in those too whose character seems perfectly different. Convulsions.

They arise from two causes.

Convulsions may be caused either from a diminution or from an increase in the circulation; or, as was observed by the father of medicine, "convulsions may arise either from inanition or from repletion."

Hippocrates, Aphor., sect. VI., 39.

Convulsions from depletion.

In most cases of those convulsions which arise from "inanition," or when such a diminution has taken place in the blood within the heart as to cause syncope, general convulsive movements succeed the loss of sense and voluntary motion; and, as has been already fully explained, the convulsions are in this case resorted to by the economy in order to increase the vigour of the enfeebled heart by increasing the quantity of its systemic blood.

See page [illegible].

And so it will be found, in all those affections of the heart that are sometimes accompanied by fits of syncope, that convulsions generally succeed the fainting state, the musculo-cardiac function, under such circumstances, invigorating the central organ, and thus causing more blood to be impelled into the cerebro-spinal system.

Convulsions from repletion.

The convulsions from "repletion" are caused by those conditions of the nervous system wherein there is a congestion of blood in the cerebral vessels; and in many of such cases the functions of the heart have been primarily disturbed; so that apoplexy, hysteria, and epilepsy are all accompanied with convulsive movements.

Other muscles besides those which are employed in the several acts of the economy for restoring a disturbed circulation are liable, although in a much less degree, to convulsive movements in disorders of the heart. Tremors, such as the trembling of the hands from fear, shivering, an inordinate desire to empty the bladder or rectum, are all examples of partial convulsive or spasmodic movements depending upon the condition of the heart.

The phenomena of *chorea* are, likewise, well worthy of contemplation; and is it not a remarkable circumstance that the unceasing movements of the muscles which take place during wakefulness should altogether cease during sleep in those afflicted with chorea? And, as the circulation is perfectly different in these two states of the system, may not the functions of the heart have a great share in causing some of the phenomena accompanying this disease?

Involuntary movements, especially of the limbs, or twitchings in particular muscles, are by no means infrequent during imperfect sleep, as happens when the circulation has been disturbed by a full stomach, by flatulence, or by the presence of indigestible food; and I have often known those with a disorder of the heart have their sleep, which usually was very imperfect, accompanied with convulsive movements, but of which they were not themselves conscious.

Paralysis;

There is another affection of the organs of active motion symptomatic of a disordered circulation, and which is of a very opposite character from convulsions, the muscles in such cases losing to a greater or less degree their contractile power, and sometimes becoming completely *paralysed.*

motor column affected in.

This affection of the *motor* column of the spinal chord may be observed in those cases of a disordered heart arising from violent mental emotion, and from the abuse of narcotics; and the impaired power of motion, remaining a very lengthened period in some cases, and in others being merely transitory.

Case.

A lady, who had a congested heart caused by grief, after losing for some time the power of motion and feeling of one side, the face and upper extremity of the body recovered, and at the same time the lower extremity of the opposite side became affected, and thus she was disabled from using both of the lower limbs.

Both motor and sensory columns affected.

Sometimes the *motor* column of one side and the *sensory* column of the opposite side become affected in the same manner.

Case.

A gentleman was attacked with a paralysis of the left side of the body, and on the following morning he had an apoplectic fit, during which the whole of the right side was in perpetual convulsions.

A similar condition of the *motor* column of the spinal chord may be observed in either several, or in only one nervous trunk. A young lady, suffering from a disordered heart, lost the power of moving the right hand to such a

Case.

degree that she was quite unable to move her fingers, but the power returned by the employment of cardiac remedies.

In some cases of paralysis, besides the loss of motion, there is also loss of sensation, both columns of the spinal chord being simultaneously affected. "In palsy the loss of *motion* is often accompanied with a loss of *sense*." Cullen.

Altered sensibility. Another class of symptoms which are met with in disturbances of the heart arise from affections of the nerves of sensation, or of the *sensory* column of the spinal chord; these nerves in one class of cases losing, more or less, their sensibility, and in another class their sensibility is morbidly increased.

Sensibility impaired. Impaired sensation of the *sensory* nerves happens in those affections of the heart wherein so great a disturbance of the circulation has been produced that some of the functions of the whole cerebro-spinal system are disturbed. In other cardiac diseases the powers of only a limited number of these nerves are impaired. Case. A young woman, afflicted with hysteria, entirely lost the sense of touch in one of her hands and fingers, whilst she retained the powers of motion.

Increased sensibility. Case. A morbid sensibility of the *sensory* nerves is by no means of rare occurrence in disorders of the heart. An athletic youth complained of tingling sensations in several of the fingers of one hand, and, after trying various means ineffectually, I was led to examine the state of the circulating organs. The radial pulse being small, and the cardiac pulse vigorous, it appeared not improbable that the sensations in the fingers might be symptomatic of a disturbed circulation affecting in a particular manner the spinal chord. Leeches were applied to the cardiac region, and, with the addition of some antimonials, all the symptoms were quickly relieved.

Neuralgic pains. A great variety of painful feelings, such as those anomalous sensations in the arms, neck, and chest, which constitute *angina pectoris*, are all referable to a disordered condition of the sensory column of the spinal chord, and have been considered to be symptomatic of an ossification of the coronary arteries. Tic douloureux. And, too, painful affections of a particular nerve, especially of the different branches of the fifth pair, may, in some instances, be observed to be symptomatic of a disturbed heart.

Case.

A woman complained for several years of a painful affection of the branches of the facial nerve of the left side, which had all the character of "tic douloureux." An increased impulse of the heart led me to apply leeches upon the precordial region, by which, along with the administration of antimonials, the action of the heart was restored, and the affection of the nerves completely subdued.

Tinnitus aurium.

Ringing in the Ears.—Of the sympathetic affections of particular nerves in diseases of the heart, there are none more remarkable than those of hearing and of sight; and, although those authors who have professedly treated of the diseases of the ear, and also of the eye, have noticed those affections, yet no one, as far as I know, has ever pointed out the important pathological fact that morbid sounds in the ears and false images before the eyes are *symptomatic* of a disordered heart, until I published, some years ago, two papers on these interesting subjects.*

See Appendix M.

Of all the symptoms derived from the cerebro-spinal system characteristic of a disordered heart, morbid sounds in the ear may be deemed one of the most remarkable.

Causes of tinnitus:

The transitory ringings in the ears, caused by violent mental emotion, offers an illustration of the effects of a disturbance in the action of the heart upon the organ of hearing; and, when there is a permanent derangement in the circulation, it can then be readily explained how the disturbed state of that organ should also become permanent, and afford a most unequivocal symptom of a disordered heart.

by a diminution of blood;

That sounds in the ears may be produced by a diminution in the supply of the arterial blood to the brain, is proved by these sounds being the effect of large depletions; and they are, indeed, well known to be the signs of approaching syncope from bloodletting. The *tinnitus* which accompanies some of the diseases of the heart may, likewise, be caused, in all probability, by the quantity of the arterial blood in the brain being diminished.

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* Lancet, 1834.

from plethora.

Besides the morbid sounds produced by a temporary diminution in the vigour of the cerebral circulation, such as take place when the heart has become overloaded with blood from violent mental emotions, there are other conditions of that organ which render it incapable, notwithstanding an increase of its impetus, to propel the necessary quantity of blood to the brain, and thus arise sounds in the ears. And it would be important to ascertain what are the particular affections of the heart which cause such morbid sounds.

Effect of the contact of the auditory artery and nerve.

That morbid sounds are produced by the movements of the bloodvessels of the ear is extremely probable from what is known of their arrangement. "The basilar artery furnishes the internal audative, a branch which passes into the internal audative canal, to be distributed on the internal ear, and is accompanied with the nerve of hearing." The close contact of the artery and nerve, and the movements of the artery being communicated to the organ of hearing by the solid bones through which it passes, have been considered sufficient to influence the functions of the nerve, and thus cause sounds.

Haller.

Character of the sounds.

The sounds which are symptomatic of a disordered heart vary in their character. They are sometimes perceived in both ears, but more generally in only one of them ; they are usually unremitting, but vary in intensity, and are louder when in bed, so much so as frequently to prevent sleep ; and they may continue for months, or even years.*

Those who are thus affected compare the unnatural noise to the rushing of waters, the roaring of the sea, the ringing of distant bells, or to the sound of boiling water, and the like.

At the same time that a person complains of such sounds, there is no change experienced in the functions of the ear, as far as regards its power of distinguishing differences in the intensity of the natural sounds.

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* Abercromby narrates a case of a person who was *deaf* when he sat up, but could hear when he was placed in the horizontal posture.

Case.

A lady was suddenly thrown into deep affliction, which was immediately followed by a violent palpitation of the heart. About fourteen days afterwards, the palpitations never having subsided, she heard a noise in one ear, which she mistook for the sound of carriages passing in the street. This noise continued, with remissions, and she sometimes perceived it in both ears.

Morbid sounds in the heart.

Besides those which are produced by changes in the circulation in the brain, there are other sounds, which originate in the heart itself, being caused by alterations of its structure, and which sounds are conveyed to the organ of hearing through the medium of the bony framework of the chest and head.

When a person is in health, and the action of the heart tranquil, its movements are quite imperceptible to himself; but whenever its impulse is increased beyond a certain limit, and more especially when the bony parietes of the chest are not loaded with soft parts, then both the impulse and the sounds of the heart may become perceptible, particularly when he is in bed.

In some diseases, especially in those where the auriculo-ventricular orifices are changed in their form, entirely new sounds are produced by the alterations in the currents of the blood; and these sounds are sometimes so intense as to be conveyed to the ear of the patient, so that when he is perfectly tranquil, and his mind undisturbed by surrounding objects, the peculiar sounds of the diseased heart become distinctly audible to himself, and are referred by him to some sonorous body at a distance.

Case communicated by Mr. Kiernan.

A countryman, in whom the auriculo-ventricular opening of the systemic heart was not larger than the diameter of a carotid artery, was, during several months before his death, much disturbed, when in bed, by a noise which he imagined to be the barking of a dog at a neighbouring farm house. On coming to London, he was surprised at being disturbed by what he supposed to be the barking of the same dog;

but his surprise ceased when it was explained to him that the sound originated in his own chest, the bellows-sound being, in his case, remarkably strong.

Ocular Spectra.—False images appearing before the eyes, and various imperfections in the functions of the retina, form another class of important symptoms in the diseases of the heart.

Many who are suffering from a permanent disorder of the heart have peculiarities in their sight, which are caused by changes in the circulation within the head; so that certain disturbances in the functions of the retina become as important diagnostic *symptoms* in diseases of the heart as those which take place in the organ of hearing.

The changes in the functions of the retina to which I allude are false images, or the appearance of bodies floating before the eyes, sparks of fire, dimness of sight, even to blindness; all which symptoms may either exist separately, and in one or both eyes, or they may be combined with other disturbances in the cerebro-spinal system.

My attention was first directed to these affections of the retina being symptoms of a disordered heart in the case of a young lady who was suffering from ocular spectra, not being able to refer this affection either to congestion in the brain, to a disturbance in the digestive organs, nor to any change in the eyes themselves, and finding that the action of the heart was considerably disturbed, the spectra disappeared whenever the healthy state of the circulation was restored by appropriate remedies.

A man who had a diseased heart for several years, brought on from running so violently that he fell down senseless, some time afterwards met with a severe affliction by which he was greatly excited, and which was immediately followed by a dimness in the vision of his right eye. Fifteen months subsequently, when I saw him, the sight was in the precise condition it was at the commencement of the disease, the sphere of vision not being altogether destroyed, so that he was still able to distinguish a small portion of any object.

The "dizzy mist swimming before the sight" of the surprised lover, so admirably described by the dramatist, points out the immediate effects of a temporary increase of the heart's action on the cerebral circulation. Page 89.

In congestion of the heart, ocular spectra are by no means an infrequent symptom; whilst in febrile diseases the appearance of false images and of *sparks of fire* before the eyes are almost constantly present, especially during the acute stage of these maladies.

> "My undulating life was as
> The fancied lights that flitting pass
> Our shut eyes in deep midnight,
> When fever begins upon the brain."
>
> BYRON.

And these affections of the retina may also depend upon a diminution of the arterial blood within the head, one of the most familiar illustrations of which being those ocular spectra which follow a large bloodletting, or a profuse spontaneous hemorrhage.

Ocular spectra, I may here observe, arise from other causes besides a disordered heart. They frequently are symptoms of some disturbance in the digestive organs, of diseases within the head, in the eye itself, or in the parts immediately surrounding the globe.

Concluding observations.

Before concluding these observations on the symptoms of diseases of the heart which are derived from the cerebro-spinal system, I may briefly recapitulate the more important points that I have endeavoured to establish.

1st. We have seen that many phenomena of the cerebro-spinal system are dependent upon the due circulation of the blood, and that all these phenomena are modified by disturbances in the circulation.

2ndly. That the changes produced in the cerebro-spinal system by disturbances in the circulation afford numerous and important symptoms in the diseases of the heart.

3rdly. That these symptoms are derived either from simultaneous changes in the functions of the whole nervous system, from changes in either of the nervous centres, or from changes in one part or an insulated portion of the brain or spinal chord.

4thly. That these symptoms are caused by changes in the circulation of the blood, either in the whole or in particular parts of the nervous system.

5thly. That changes in the circulation are caused by alterations in the proportions of the arterial and venous blood in the whole or in particular portions of the cerebro-spinal system.

6thly. That the various changes in the whole or in portions of the cerebro-spinal system during sleep and wakefulness afford evidence of the influence of the circulation upon the functions of that system.

7thly. That, although some of the diseases of the cerebro-spinal system may be caused by morbid changes primarily affecting that system, yet most of the diseases which are usually called "*nervous*" depend upon a primary disorder of the heart.

8thly. That the different kinds of *fits* arise, in most instances, from disturbances in the cerebro-spinal circulation, caused by a disorder in the functions of the heart.

9thly. That one class of these fits arises from changes in the systemic, and another class from changes in the pulmonic, heart.

10thly. That pathological science has not yet advanced so far as to enable us to discriminate what are the particular disorders of the heart which affect insulated portions of the nervous system, and which cause the particular symptoms; and how it is that, in the case of several persons with apparently the same condition of the heart, one of them should have ocular spectra, another ringing in the ears, another convulsions, and another palsy.

11thly. That the various phenomena of the cerebro-spinal system caused by modifications in the circulation have a strict analogy to the effects of those medicinal substances which influence one portion only of the nervous system.

CHAPTER IX.

SYMPTOMS OF DISEASES OF THE HEART DERIVED FROM THE RESPIRATORY SYSTEM.

Co-operation in the functions of the respiratory organs and the heart, both in health and in disease; intimate relation of these two organs; the particular symptoms in diseases of the heart derived from changes in the respiratary system; table of the symptoms; symptoms from changes in the pul no-cardiac function; changes in the frequency, rhythm, and intensity of the breathing; pulmonary hemorrhage; pulmonary apoplexy; sobbing; sighing; weeping; screaming; laughing; sneezing; hiccup; changes in the voice.

Reciprocal influence of the lungs and heart

When investigating the semiology of the heart, and prosecuting our inquiries into the influence of its disordered functions upon the different systems of the economy, of no less importance, we shall find, than the cerebro-spinal system is the *respiratory*—a system with which the functions of the heart are so intimately associated in the healthy state of the body, and which is alike influenced by that system when there is any disorder in the central organ of the circulation.

Illustrated in their diseases.

Some, indeed, of the disorders of the pulmonary apparatus of which I am about to treat may have been considered by pathological writers as symptomatic of a diseased heart; yet there are others which have been entirely overlooked; and, as I had occasion to mention when pointing out the symptoms of a disordered heart which are derived from the cerebro-spinal system, so I shall now endeavour to show that there are pulmonary affections which, although they have been arranged in systems of nosology amongst the *idiopathic* diseases of the lungs, are, in reality, *symptomatic* of a disordered heart.

Some pulmonary disorders are symptomatic of a diseased heart.

Further, it will appear that, as many symptomatic affections of the cerebro-spinal system are successfully treated by those remedies which exercise their influence upon the heart, so, likewise, there are many affections of the respiratory organs, which are relieved by those means which are known to have a direct or specific influence upon the organs of circulation.

Co-operation of the lungs with the heart in their diseases.

All the modifications to which the functions of the respiratory organs are liable are to be met with in disorders of the heart; and, the functions of the heart and lungs being so intimately associated in their healthy condition, no change, however slight, can take place in the functions of the one organ without producing some corresponding change in those of the other.

However great may be the influence which the functions of the lungs have upon the heart, in a still more remarkable degree do the functions of the heart influence the respiratory organs. The heart's actions are necessarily varying, from the almost constant changes required in the distribution of the blood to the various organs; but respiration is always equal and regular unless when, from changes in the heart, the pulmonary circulation suffers a corresponding change.

The lungs form the link between the right and left hearts.

The two hearts have no immediate connection with one another excepting through the medium of the lungs. The currents of the blood poured out from the systemic heart, however modified may be the stream, can have no influence on the right heart, at least until the blood has passed through the whole capillary and venous systems. The lungs, indeed, form the only link between the right and left hearts, a direct communication existing between them through the pulmonary vessels; and this relation between the organs of circulation and respiration is strikingly illustrated by the effect which increasing the respirations has in increasing the action of the heart, and the quickening of the respiration by the increase of the circulation.

See p. 59.

Both the lungs and heart are simultaneously influenced by mental emotion.

The influence of mental emotions on the heart causes likewise a corresponding effect upon the organs of respiration:—

> " Not heart, but *breast* did beat,
> So much deranged all seemed ;"

and, besides the changes in the breathing, " the breathless anxiety" of those suffering from violent mental excitement, there are changes in the expression of the countenance which have been so faithfully delineated by Sir Charles Bell, and so admirably explained by the respiratory nerves.

Influence of the *pulmo-cardiac* function;

In the healthy state of the thoracic viscera I have endeavoured to demonstrate that the pulmonary vessels, besides conveying the venous blood from the heart to the lungs, and again returning it, arterialised, from the lungs to the heart, perform another very important function in the circulation, by receiving all such blood as the heart's cavities have not the capacity to contain whenever the exit of the arterial blood from the left heart is impeded, or the return of the venous blood to the right heart is accelerated. This function of the lungs is perfectly distinct, and of quite a different character, from the function of arterialising the blood. It is purely a physical function, whereas the oxygenation of the blood is a chemical one. Hence life may be extinguished or suffocation may be caused either by the pulmonary circulation being stopped, producing pulmonary congestion, or by the inhalation of deleterious air destroying the vital properties of the blood.

symptoms from changes in it;

By a knowledge of this *pulmo-cardiac* function we are enabled to explain not only many physiological phenomena but we can satisfactorily account for many *symptoms* in the disorders of the heart—symptoms wherein modifications take place in the quantity of blood congested in the pulmonary vessels; and it matters not what the disease of the heart is that causes an impediment in the pulmonary circulation, for it is sufficient to effect such a purpose that the currents of the blood in the interior of the heart be altered, whether from a change in the cavities of the right or left side, or in the cavities of both hearts.

We may, indeed, observe a chain of symptoms caused by disturbances of the *pulmo-cardiac* function, varying from a slight and merely temporary alteration of breathing, and progressively increasing in severity until we meet with examples in which the impediment to the pulmonary circulation is so considerable as to create much embarrassment of breathing, asthma, cough, and even pulmonary hemorrhage.

connection in the diseases of the lungs and heart.

From the account which has been given of the nature of the *pulmo-cardiac* function, it is quite evident that no change can take place in the action of the heart without producing an immediate and direct influence upon the pulmonary circulation. And, if we but glance over the phenomena of life, every perceptible alteration in the functions of one of these two vital organs will be observed to be followed by some modification in the functions of the other. The heart cannot have its beats increased, however slightly, without respiration being proportionably quickened; and, if such be the connection in the healthy condition of these organs, what are we to look for when either of them becomes diseased? And is it not legitimate to conclude that the same cooperation and dependence of the heart upon the lungs, and of the lungs upon the heart, so remarkable in health, will be developed when the functions of either of them is disordered?

The truth of this induction receives additional confirmation by many pathological facts, and its importance in the healing art cannot be too much dwelt upon. It will enable us to discriminate what are the idiopathic or primary, and what are the symptomatic or secondary, affections of these two systems, the circulatory and respiratory; it will account for many serious errors which have crept into our systems of nosology, whilst it will also lead ultimately to a rational method for the treatment of many of the diseases of the thoracic viscera.

Relation of the lungs, heart, and brain.

The foregoing remarks equally apply to the cerebro-spinal system, which, as has been shown, is influenced by every change in the functions of the heart, so that the three vital organs—the lungs, the heart, and the brain—are all so intimately associated that it is impossible that any disturbance can take place in the functions of the one without some corresponding change in some of the functions of the others.

Pulmo-cardiac congestion explained;

When there is merely a temporary increase in the action of the heart, such as that caused by violent exercise, or from sudden mental excitement, a corresponding frequency will be observed to take place in respiration; and, the blood being the natural stimulus of the heart, the increased frequency of the breathing and of the beatings of the heart which are thus produced have the effect of reducing within the scope of the natural standard more or less quickly whatever blood may have been congested in the thoracic viscera.

Illustrated in animals.

These phenomena we see exemplified when a person performs any act of great muscular exertion; and in a still greater degree may they be observed in those animals remarkable for their speed, as the greyhound after a long chase, the great impulse of the heart and the rapidity in breathing continuing a very considerable time before the respiratory and circulating organs become tranquillised.

How pulmo-cardiac congestion is warded off by the economy.

But, whenever the *pulmo-cardiac* congestion is such that the increase in the frequency of the action of the heart and in the respiration are not sufficient to eject the superabundant blood and restore the due balance of the circulation, then the breathing becomes modified by those acts of the economy by which both the heart and respiratory organs are further enabled to expel the congested blood.

These acts enumerated as symptoms.

Now, the acts of the respiratory organs to which I allude—sobbing, sighing, weeping, laughing, crying, coughing, sneezing, hiccup—are likewise resorted to by the *vis medicatrix naturæ*, and are instinctive efforts employed to restore those disturbances in the circulation which have been caused by disorders of the heart.

Pulmo-cardiac congestion becomes permanent.

But these acts—these means possessed by the system for restoring the balance of the circulation—are not sufficient to relieve the pulmonary vessels and heart of congestion when it has advanced beyond a certain degree; and hence is produced that permanent difficulty of breathing, dyspnœa, asthma, cough, and hæmoptisis—symptoms all of which are so frequent in those afflicted with some disorder of the heart. Indeed, the disarrangements of the *pulmo-cardiac* function, from the changes which they produce in respiration, and

Diagnosis of *pulmo-cardiac* congestion very important.

especially the cough and the hæmoptisis, often mislead; and I may confidently assert that I have almost daily opportunities of observing cases which have been considered primary affections of the lungs, but in which all the symptoms were traced to a disordered heart, and permanent relief obtained by restoring its functions.

"In those affections of the heart which come on suddenly, as after a violent effort, a blow, or a strong, violent emotion, the respiration is sensibly altered the very moment when the cause has been applied, and often the difficulty of breathing is the first symptom which announces the approaching disease."

Corvisart.

The particular symptoms.

Having premised these general observations on the influence which disturbances of the heart create in the respiratory apparatus, let us examine, more at length, some of those *symptoms* which have been enumerated,* and by which we shall be enabled the better to appreciate their importance in the semiology of the heart.

Differences observed in healthy respiration.

Respiration, it may be remarked, like circulation, is constantly varying, not only in every healthy individual, but it varies also in different persons, all of whom are apparently under the same circumstances.

See p. 8.

The lungs appear to require different quantities of air for the arterialisation of the blood, just as the heart is furnished, at different times, with different quantities of the vital fluid; so that it becomes a nice point to determine the precise boundary between the healthy and the diseased condition of respiration. Indeed, it is only during sleep, when the frequency of the aspirations, or the action of the heart, can be said to be perfectly tranquil, and when the vigour of respiration, as well as of circulation, is greatly diminished.

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* TABLE

OF THE SYMPTOMS DERIVED FROM THE RESPIRATORY SYSTEM.

Dyspnœa,
Asthma,
Wheezing,
Coughing,
Pulmonary hemorrhage,
Pulmonary apoplexy,
Hiccup,
Sobbing,

Sighing,
Yawning,
Weeping,
Laughing,
Sneezing,
Crying,
Screaming.

The capacity of the lungs.

"The lungs are computed to contain, at the time of their utmost fulness, about 220 cubic inches of air. When we continue breathing in a natural and easy way we draw in and expel alternately about forty cubic inches; but, when we choose to force respiration, we can expel, without danger or harm, about seventy inches more: we can expel 110 inches of air, leaving only 110 inches in the lungs. There remains always in the lungs a great mass of air, and which I call the *permanent* dilatation of the lungs;" so that in like manner as the heart's cavities are never completely empty of blood, the lungs always retain a certain quantity of atmospheric air.

John Bell's Anatomy.

From the great variety in the number and in the extent of the inspirations in different persons, we are led to infer that to sustain animal life very different quantities of atmospheric air are required by different individuals; and this is confirmed by the extraordinary number of the bronchi which have been so frequently found after death completely obliterated, and where the powers of life have appeared to be little diminished, even towards the close of life.

Frequency of the aspirations.

One aspiration, in a person in health, takes place for every four beats of the pulse, two pulsations being made during inspiration, and other two during expiration; so that the pulse may always be a guide for determining the frequency of respiration, as well as the number of the aspirations determine the frequency of the pulse; and, as the ordinary pulse of an adult is calculated at about seventy beats in a minute, the average number of the aspirations will be eighteen. One physiologist, however, has calculated that the aspirations vary from twelve to fifteen, another that they may be reckoned at twenty, and another at twenty-six, in a minute. This contradictory account of so common a phenomenon can only have arisen from want of due attention to the particular state of the individuals on whom the observations were made.

Differently estimated by Laennec, Bostock, and others.

As there can be no change in the functions of the heart without accompanying changes in the pulmonary circulation, a variety of conditions of the respiratory apparatus becomes manifest in disturbances of the circulation; all such modifications in respiration, as I formerly remarked, being instinctive acts of the economy made to restore and preserve the proportion that is necessary between the quantity of air and blood within the lungs.

In affections of the heart, respiration will be found liable to changes in its frequency, to changes in its rhythm, and to changes in its intensity.

Changes in the frequency of respiration.

Respiration varies in its *frequency* in different disorders of the heart. In some affections the number of the aspirations are very much increased, such as in the inflammatory diseases of its different textures; whilst in another class, where the circulation is feeble, the frequency of respiration is greatly below the natural standard.

Changes in the rhythm.

The most remarkable change of respiration in disorders of the heart is when the inspirations and expirations do not preserve their natural *proportions;* for sometimes the inspirations are lengthened, and the expirations abbreviated; sometimes the inspirations, and at other times the expirations, are prolonged; and sometimes the expirations are made with great difficulty. These changes in the breathing are constantly taking place in the various instinctive acts employed by the economy to preserve the balance of the circulation, and they are likewise seen in diseases.

"In long retentions of the breath," observes Haller, "as in making violent efforts, the *venous* blood, especially of the head, stagnates before the right ventricle, which is closed up because it cannot evacuate its blood into the lungs; and, tumefying the face with redness, the blood sometimes bursts the veins of the brain, neck, intestines, kidneys, or lungs, or even the right auricle. This is the cause of excessive anxiety of mind; this is the cause of death in compressed *air*, in persons who die suddenly when evacuating the bowels, or in persons drowned or strangled, and which is much more sudden than is usully imagined with regard to drowned people.

"A living person, therefore, that he may remove those inconveniences which arise from the passage of the blood being obstructed, slackens the powers of inspiration and excites the action of those of expiration, in order to free the breast from the too greatly rarefied air. Hence expiration is performed more easily and quickly than inspiration."

Dyspnœa and asthma.

A change in the rhythm constitutes *dyspnœa* and *asthma*; the first signifying merely a lesser degree of difficulty in breathing than the second; and, although these terms imply only the *symptoms* of a disturbed circulation, they have been considered primary diseases, and arranged by Cullen under the class of "spasmodic affections without fever."

Changes in the intensity of respiration.

In its *intensity*, respiration undergoes various changes in disorders of the heart; sometimes becoming so extremely feeble as to render the voice almost inaudible.

Case recorded by C. Bell.

A paralytic patient ceased to breathe the moment he fell asleep, so that he awoke the next instant from the sensation of suffocation. When sleep began to overpower him, respiration became slow, the pulse fell, and the heart's action even ceased.

These varied changes in respiration may doubtless be also present when there is a primary disease in the lungs, and which disease may have caused such disturbed action of the heart as to produce derangement of the *pulmo-cardiac* function; but this function cannot be deranged without being accompanied with a corresponding change in the functions of the heart.

It is important to decide how far the peculiar disturbances in respiration which have been alluded to are to be considered pathognomonic of a disordered heart; and though Corvisart, that acute observer, has remarked that "the disturbances we observe in respiration, considered isolatedly, only give equivocal signs of these affections of the heart, because in general they are common to several diseases of the chest," yet it appears to me that in all cases where the disturbances in respiration are of that character, or those which arise from a derangement of the *pulmo-cardiac* function, such disturbances may undoubtedly be considered as pathognomonic of a disordered heart, always being aware, in forming a diagnosis, that the history of the symptoms, the character of the accompanying cough, and the anatomical symptoms must be taken into consideration whenever we endeavour to discriminate the true nature of the disease.

Coughing.

Coughing.—No symptom more unequivocally characterises a disturbance of the pulmonary circulation than cough; and, as such disturbances are often accompanied with a corresponding change in the heart's action, cough may be classed among the *symptoms* of a disordered heart, as well as a symptom of diseased lungs.

The two offices performed by the lungs.

When enumerating the different offices performed by the respiratory apparatus, it was stated that one of these was *coughing*, and that this act was resorted to by the economy to effect one of two purposes: either to restore a disturbed circulation in the lungs, or to evacuate some morbid secretions or extraneous substance from the bronchi.

Now, the characters of each of these coughs, it is essential to observe, are perfectly different. The one is dry, with convulsive movements of the thorax, more or less violent, as may be necessary for restoring the pulmonary circulation, and the other is comparatively less severe, being only required for expelling some morbid secretion from the bronchi.

Imperfect arrangement of coughs.

Though pathologists have attempted to arrange coughs into two classes,—the *dry* and the *moist*,—yet, on examining minutely the diseases of the chest, we are struck with an apparently endless variety in the characters of the coughs by which they are accompanied, and how imperfect is such an arrangement.

Varieties of coughs.

Nothing can differ more from one another than the slight, short, tickling, dry cough which accompanies tubercular disease of the lungs; the severe paroxysm of coughing, with profuse expectoration, characteristic of inflammation of the mucous membrane of the bronchiæ; the short, dull, dry cough, accompanied with local pain, of pleuritis; the violent spasmodic cough, with sense of suffocation from some local irritation of the larynx, an elongated uvula, or inflammation of the mucous membrane of the pharynx or upper part of the larynx; the spasmodic paroxysms of coughing, without expectoration, which depend upon derangement of the digestive organs; the violent spasmodic cough, with prolonged inspirations, followed by vomiting, which is peculiar to hooping-cough; the *laryngismus stridulus* of infants; the dry, hard, and suffocating cough, the pathognomonic symptom of croup: all these differ essentially from a paroxysm of the dry cough, with more or less dyspnœa and embarrassment of breathing, which arise from a disturbance of the pulmonary circulation caused by a disordered heart.

That coughs should assume so many different characters may be readily explained by contemplating the respiratory organs as a simple physical apparatus; for it is quite evident that, according to the intensity and duration of the expirations, so will the sound be varied, just as the tones of a common trumpet are changed by the blast of air which is passed through it.

Their discrimination important.

But to be able to discriminate these different coughs, and refer each to a particular condition of the pulmonary apparatus, requires the same tuition of the ear as the sense of *touch* requires to discriminate the various changes in the arterial pulse.

Character of the cough accompanying a diseased heart.

The cough symptomatic of a disordered *heart* is harsh and loud, comes in severe paroxysms, and is usually brought on by some movement of the body, such as lying down, and especially on rising up in bed, by turning in bed, or by speaking more or less loudly; but there is seldom cough when the body is perfectly still. There is no expectoration accompanying the cough, but there is sometimes nausea towards the end of the paroxysm, and there is often great exhaustion from the violent action of the respiratory and abdominal muscles. Such is the violence of the expirations, that the involuntary discharge of urine during a paroxysm of coughing is not an unfrequent occurrence, especially in women and those of a nervous temperament; and this symptom sometimes takes place to so great an extent as materially to distress the sufferer.

[illegible]

These phenomena all confirm the explanation I have given of the cause of this particular cough; for it is quite evident that it is brought on by whatever excites even in the slightest degree the action of the heart, the act of coughing relieving the heart and lungs of the increased quantity of blood which is congested in the pulmonary vessels. Hence can be satisfactorily explained how such coughs are diminished by avoiding whatever causes the slightest increase of blood in the chest; and I think it extremely probable, as before remarked, that the relief which many so affected find from the use of lozenges arises from the mouth being kept closed, and thus limiting the inspirations.

The cough which arises from a disturbance in the pulmo-cardiac function may be combined with other diseased changes, more especially with inflammation of the mucous membrane of the bronchiæ; so that, whilst the characters of the cough caused by a disordered heart are all present, there will be also other symptoms, the most striking of which is a morbid expectoration of mucus, causing the cough, in place of being dry, to become moist.

Pertussis.

Along with those coughs which are connected with a disturbance of the functions of the heart may be mentioned *hooping-cough*; for, whether the respiratory organs or the heart be primarily affected in this disease, the functions of both organs are so greatly influenced, that there is always, throughout its progress, a complicated assemblage of symptoms arising from both the respiratory and circulating organs being deranged; and this connection of the respiratory organs with the heart in hooping-cough is corroborated by some of the most efficacious remedies in that disease, such as the sulphates of zinc and of alum and hydrocyanic acid, being those which are known to have a specific action on the circulation.

Hæmoptysis.

Pulmonary Hemorrhage.—A spontaneous bleeding from the capillaries of the gastro-pulmonary mucous surface is, perhaps, one of the most unequivocal symptoms of a disordered heart; and there are few cases where the thoracic circulation has been either much or for a long time disturbed in which some spontaneous hemorrhage, more or less frequently, has not occurred either from the capillaries of the pulmonary, ethmoidal, or portal vessels.

Pulmonary hemorrhage is caused, I am convinced, far more frequently by *pulmo-cardiac* congestion than from any idiopathic disease of the lungs, though it has usually been considered as a symptom of some primary affection of the respiratory organs.

Beneficial effects of.

It is the more remarkable that pulmonary hemorrhage should have been so generally considered to be the consequence of an organic disease of the lungs, when medical records abound with examples of persons recovering from very profuse and repeated attacks of spitting of blood, and who were permanently relieved of *pulmo-cardiac* congestion.

"However severe the affection may be, the resolution of pulmonary engorgement appears to take place with great facility, for we see a great number of persons who have recovered after having been the subjects of repeated abundant hæmoptysis."

Laennec.

The circumstance that pulmonary hemorrhage is not always followed by pernicious effects on the system is a strong proof that such spontaneous bleedings may take place perfectly unconnected with an ulceration of the lungs, or with any other organic change in that viscus; and Portal observed, "that those who habitually spit blood are rarely phthisical."

This subject, indeed, opens an inquiry of the deepest practical importance, and from the physiological views of the pulmonary circulation which I have endeavoured to establish, as well as from numerous pathological facts, it will, I am persuaded, appear that as many cases of *cough* which have been considered to be the effects of diseased lungs are symptomatic of a disordered heart; so in many instances pulmonary hemorrhage may take place unconnected with any diseased structure of the lungs, but caused by a disturbance of the *pulmo-cardiac* function.

Pulmonary hemorrhage symptomatic of a disordered heart may occur in every possible degree; in some cases the sputa being only slightly tinted with blood, and in other examples the quantity of blood is surprising.

Case.

A lady, after running violently from fear, spat up, in a few minutes afterwards, a large quantity of blood, and continued to expectorate a small quantity almost every day during the subsequent twenty years of her life. In another case ten pints were coughed up in twenty-four hours.

Laennec.

Case.

A lady, in the bloom of life, was suddenly attacked, when riding on horseback, with hemoptæ, and spat up several pints of blood, and she enjoyed perfect health many years afterwards.

Premonitory symptoms of hæmoptysis.

These hemorrhages are not attended with febrile symptoms, but, when profuse, are usually preceded by a rigour which, by increasing the quantity of blood in the internal organs, renders the pulmonary vessels more turgid, and, by causing them to give way more easily, aids the efforts of the *vis medicatrix*.

The hemorrhagic paroxysm, too, is preceded by coughing, just as bleeding from the nose is by sneezing, and the hemorrhoidal flux by tenesmus and purging.

Pulmonary apoplexy.

Pulmonary Apoplexy.—It has been pointed out that *pulmo-cardiac* congestion is sometimes relieved by a *spontaneous* hemorrhage, the blood being exuded from the mucous capillaries of the lungs; but in other cases, when the congestion takes place to a greater degree, the pulmonary vessels are ruptured from over-distention, and hence is also caused a pulmonary *apoplexy*.

In this case the blood, in place of being exuded upon the mucous surface, is effused into the parenchyma of the lungs from ruptured vessels, and where it remains, having all the characters of an *ecchymosis* in other structures. There must, therefore, be a remarkable difference in a lung that has been affected with *hæmoptysis* and one with pulmonary *apoplexy*, the blood in the first case making its escape by expectoration, whilst in pulmonary apoplexy the blood consolidates and renders whatever portions of the lungs into which it has been effused unfit for the arterialisation of the blood. Consequently we must expect to find a permanent defect in respiration in all that portion of the lung which has had its air-cells obliterated, and a corresponding change in the action of the heart. This, I suspect, is precisely the change that has taken place in those who never completely recover their natural breathing after severe *pulmo-cardiac* congestion, such as that caused by some violent muscular exertion or great mental excitement. And in those where life is extinguished from *pulmo-cardiac* congestion, and in those also that have died from hanging or drowning, blood in all these cases is found effused into the *parenchyma* of the lungs.

Changes in the respiratory murmur.

The Respiratory Murmur.—Besides changes in the frequency, rhythm, and intensity of the aspirations, there are also changes in the respiratory murmur which are caused by disturbances in the heart.

The respiratory murmur is sometimes loud, or sometimes feeble, or it is altogether absent in some disorders of the heart where the circulation has become extremely languid. Sometimes it is harsh, varying in force, hard, and dry; and sometimes it is of a hollow or cavernous character.

The morbid sounds so frequently met with in primary affections of the lungs may also take place combined with disturbances in the functions of the heart. There may be either a moist, though far more frequently a dry, husky sound mingled with the respiratory murmur, or the sound may be sonorous, crepitating, or gurgling; but these sounds, when they accompany a disordered heart, are the effect of changes which have taken place in the lungs themselves, especially in their mucous membrane, and which structure is more or less affected in most instances of cardiac disease, especially in those of an acute character.

Singultus.

Hiccup often takes place in persons who have disorders of the heart; so that, in cases of hiccup, particularly in those where it is prolonged to any considerable period, it may be suspected that there exists some disturbance in the circulation.

Case.

A gentleman, after recovering from the more severe effects of a fit of venous apoplexy, and in whom the circulation of both the portal and cerebrel systems was greatly disturbed, had an almost incessant hiccup whilst he was awake, which continued during fourteen days.

It is by no means unfrequent to observe a paroxysm of hiccup following that disturbance in the condition of the heart subsequent to a fit of laughter.

See p. 30. A case has already been referred to where, after an immoderate fit of laughter, a violent hiccup came on, which caused great uneasiness in the cardiac region, and was relieved by local bloodletting.

At the same time it must be kept in mind that hiccup may be symptomatic of affections of other organs. In some instances it appears to be connected with a derangement in the functions of the alimentary canal; and it is considered to be a fatal symptom when a portion of the intestines has become strangulated. It is, also, of constant occurrence in children who are apparently in health.

A man, after a debauch, was attacked with a severe and incessant hiccup, and, having lasted some days, it ceased immediately after the contents of a large abscess were artificially discharged; and then it was found "that the whole course of the external respiratory nerve was engaged in the abscess."

Note of a case by Mr. Mackenzie.

Sneezing.

Sneezing is another symptom which may be sometimes observed in persons with a disordered heart. I have already made allusion to the remarkable sympathy which subsists between the heart and the organ of smell and the influence of odorous substances upon the heart, the act of sneezing being employed by the system, not only for removing extraneous matters irritating the Schneiderian membrane, but also, like other instinctive acts of the economy, it is resorted to in order to restore the balance of a disturbed thoracic circulation.

Case. "A lady, who had been subject to a disturbed circulation and was considered to be hysterical, had a violent paroxysm of sneezing, which, after lasting nearly an hour, became very alarming; but, on a vein in the arm being opened, she was immediately relieved.

Case. "A lady was liable to fits of incessant sneezing, attended with a most abundant flow of watery fluid from the nostrils. This sometimes alternated with a nervous cough, while not unfrequently she suffered under that sensation in the throat called *globus hystericus*." Brodie on Local Disorders, p. 61.

Epistaxis. In like manner as the act of coughing produces pulmonary hemorrhage, so we often find that a paroxysm of sneezing causes a spontaneous hemorrhage from the *Schneiderian* membrane; hence in all cases of *epistaxis* it is of consequence to inquire into the condition of the thoracic viscera, as well as into that of the cerebral circulation.

Case. A naval officer could at any time produce so great a disturbance in the action of the heart by drinking coffee as to cause some blood to flow from the nose. See p. 137.

Influence of other instinctive acts. I have already pointed out and endeavoured to explain certain instinctive acts which are employed by the economy in order to restore those temporary changes and derangements in the circulation of the thoracic viscera which are constantly taking place in a healthy person during wakefulness; and as these acts are also observed in those suffering from diseases of the heart, being resorted to by the *vis medicatrix*, in like manner as they were employed by the *vis conservatrix naturæ*, in order to correct and ward off the evil effects of impediments to the circulation, they may be, with propriety, added to the catalogue of *spmptoms* of diseases of the heart. See p. 73.

I have formerly alluded to the salutary effects of some of these instinctive acts upon a disordered heart—how, in one instance, a paroxysm of syncope, to which the person was subject, could be prevented by her singing; how a youth could prevent an epileptic paroxysm by repeating aloud the Lord's prayer; and how another revived the circulation, when he found himself breathless, by vigorous breathing: all these individuals suffering from some disease of the heart.

Laughter, which I have explained has so powerful an influence upon the heart, is also a symptom of a disordered circulation, and is frequently observed in those whose hearts are easily excited, especially in hysterical women. See p. 74.

Whilst moderate fits of laughter, such as those which accompany cheerfulness and mirth, relieve the circulation, and

> "Cleanse the foul bosom of that perilous stuff
> Which weighs upon the heart"—(SHAKSPEAR),

See page 76. violent paroxysms of laughter cause pain in the cardiac region, and sometimes disturb the heart to so great a degree as to cause fatal convulsions.

Sobbing, sighing, weeping, and *crying* have, likewise, been each shown to be instinctive acts resorted to by the economy, in order, at all times, to preserve and restore the balance of the circulation in the thoracic viscera; and they also frequently accompany the heart's diseases when, no doubt, they execute the same office.

"*Sighing* is caused by the drawing in of a greater quantity of breath to refresh the heart that laboureth, like a great draught when one is thirsty. *Sobbing* is the same thing, stronger. *Groaning,* and *screaming,* and *roaring* are caused by an appetite of expulsion, as hath been said; for, when the spirits cannot expel the thing that hurteth, in their strife to do it, by motion of consent, they expel the voice." Bacon.

A young lady, who, after severe mental excitement, awoke, screaming violently, continued for two years afterwards to suffer from a sense of fulness, and sometimes pain in the region of the heart, a strong impulse of the heart, and a small, contracted arterial pulse, coldness of the extremities, and frequent paroxysms of *yawning, sobbing,* and *sighing,* but no cough or difficulty in breathing; and all which symptoms yielded to the application of a few leeches to the cardiac region, and the use of antimony and iron.

Changes in the voice.

The Voice.—In those disturbances of the heart which influence the respiratory organs there may be likewise observed corresponding alterations in the voice.

The formation of the voice being one of those several functions performed by the respiratory apparatus, it must happen that not only the vocal organs are changed in primary affections of the lungs, but also in all those of the heart wherein the pulmonary circulation is disturbed.

The lungs being employed to impel the air through the vocal organs, all changes in the force of the current of the air must be caused by changes in the functions of the lungs, many of which changes arise from disorders of the heart; and the peculiarities in the voice denoting disturbances in the functions of the heart will be found to be an order of *symptoms* of no inconsiderable value in semiology.

The changes of the voice in disorders of the heart consist of alterations in the compass, tone, and intensity of the voice.

Changes in its compass.

In *compass*, we may perceive that when the lungs cannot expel a sufficient quantity of air, and with sufficient force, through the larynx, not only is speech abbreviated, but the higher notes of the voice become more or less imperfect, so that in speaking there is generally an alteration in the musical key on which the voice is pitched, and a person who in health is able to sing is quite incapacitated from doing so when the thoracic circulation is much disturbed.

Changes in its tone.

The *tone* of the voice varies exceedingly in disorders of the heart, and the changes in it are readily perceptible to a musical ear.

Sometimes the voice becomes more or less harsh, rough, and unmusical; and there is often, too, considerable uneasiness and difficulty in producing any articulate sounds.

Case.

A youth suffered from *pulmo-cardiac* congestion, caused by *asphyxia*, and he was long afterwards subject to a disordered heart, on many occasions losing his voice for a few minutes.

It may be remarked how exceedingly the tone of the voice varies in different people, and how much character there is in the voices of all the branches of the same family.

The tone of the voice, too, is variously modified according to the difference of sex and of age.

Changes in its intensity.

The *intensity* of the voice is considerably altered by those changes in the respiratory functions which depend upon the condition of the heart. Every alteration in the volume of the column of air expelled through the larynx during expiration must produce a change in the voice, so that in all those diseases of the heart in which the pulmonary circulation is influenced the voice will be more or less changed: at the same time, changes either in the larynx, in the trachea tube, as well as in the lungs, must, by altering the volume and force of the current of air, alter the intensity and the tones of the voice.

CHAPTER X.

SYMPTOMS OF DISEASES OF THE HEART DERIVED FROM THE VASCULAR SYSTEM.

Symptoms derived from the arterial system ; *importance of a knowledge of the arterial pulse ; the arterial pulse an essential guide in pointing out the condition of the left heart ; functions of the arteries liable to changes independent of the heart ; the arterial pulse varies in frequency, regularity, and vigour ; table of the different pulses ; the arterial and cardiac pulse do not always correspond ; symptoms derived from the* venous system ; *these symptoms point out diseases of the right heart ; congestion of the subcutaneous veins ; congestion of the cerebral and portal systems ; the venous pulse ; œdema ; symptoms derived from the* capillary system ; *changes in the cutaneous surface ; redness, paleness, lividity, heat, coldness, shivering, hemorrhage from the gastro-pulmonary mucous surface.*

The arterial pulse.

As the flow of the blood in the arteries depends chiefly on the action of the heart, the functions of the arteries must undergo alterations in accordance with changes in the heart's functions; and such varied conditions of the arterial system afford unequivocal *symptoms* of the heart's diseases. The arterial pulse, indeed, has been, since a very early period of the history of medicine, considered as an index of the state of the heart.

"The pulse is the measure of the powers exerted by the heart, because it is the immediate and full effect of these powers. Hence, all things alike, the pulse is slow in the state of perfect health, when there is no stimulus, no resistance acting as a stimulus; and the heart propels the blood freely and easily, except where there is some obstacle by which the blood is prevented from entering the aorta."

Haller

Importance of a knowledge of the pulse.

As changes in the arterial pulse denote corresponding alterations in the heart's movements, and afford numerous and important diagnostic signs in the diseases of that organ, an intimate acquaintance with these, along with a knowledge of those changes which take place in the nervous and respiratory organs, are, it will be found, as indispensable for establishing a correct diagnosis in diseases of the heart as a knowledge of the impulse and sounds of the heart itself. Besides, the facility with which the pulse can be examined renders the various changes which it presents in diseases of the heart most important.

For various reasons we have not the opportunity of examining the cardiac so rigidly and accurately as the arterial pulse, especially the pulsation of those arteries which are adjacent to a bone, such as the radial or temporal, therefore many lesser, or at least less apparent, changes in the circulation are readily recognised by examining the radial pulse.

Until Laennec pointed out the changes to which the sounds of the heart are liable, we had no other means of ascertaining the alterations in its functions than by observations on the arterial pulse, together with the effects which the changes in the circulation cause on the other systems, more especially on the nervous, respiratory, and digestive systems; and, limited as the means of diagnosis might then have been, I am persuaded that fewer and less serious mistakes were committed than we now see made by those who look chiefly to the physical signs of the diseases of the thoracic viscera, and disregard that general assemblage of symptoms which accompany those affections, and which arise from the disturbance of other organs or other systems of the economy.

In considering those alterations in the arterial pulse which are characteristic of changes in the central organ of the circulation, pathological inquirers speak of the heart in general, and not of any of its particular portions.

The pulse indicates changes in the left heart only.

But it is quite evident that, as the arterial pulse is a measure of the currents of the blood in the *left* heart, alterations in the pulse must arise from, and be characteristic of, those alterations in the blood's currents which are produced by changes in the systemic heart. "The examination of the radial pulse is far from being able to give an idea of the general circulation, and cannot even give a knowledge of the circulation in the heart, for the pulse corresponds only with the left ventricle, and this may be regular when those of the auricles or right ventricle are not so." **Laennec.**

Hence arises a distinct and important line of demarcation between the diseases of the pulmonic and those of the systemic hearts, the affections of each being accompanied by systoms of very different characters.

Whilst the opinions of physiologists remain so unsettled as to the causes of the *sounds* of the heart,—the mode by which the blood is propelled through the arterial canals,—and the functions which even the coats of the arteries perform, it cannot be expected that the various alterations in the functions of the arteries as indicated by the pulse could be very satisfactorily explained.

It is, however, essential to observe the various changes which take place in the arterial pulse in the different diseases of the heart, and endeavour to discover as far as possible the alterations in its structure and functions, with which they correspond.

Pulse altered from various causes.

Observation has shown that the pulse is altered both from organic and functional diseases of the heart, and that certain states of the pulse not only accompany particular diseases, but also indicate the use of particular remedies. We can by the pulse chiefly discriminate those diseases which require an antiphlogistic treatment from those in which an opposite system is necessary. In the first instance, the irritable state of the heart's parietes may cause an increase in its impulse which is tranquillised by diminishing the quantity of the stimulating blood, whilst in the latter case the pulse may be rendered more frequent by a debilitated state of the body. The left ventricle, not being so capable of emptying itself, sooner dilates, and consequently is sooner stimulated by the blood to contract, a greater number of contractions being requisite to propel a sufficient quantity of blood throughout the system.

We further know that all impediments to the circulation influence and modify the arterial pulse. If the blood's stream be impeded in the aorta, or in passing from the right auricle into the right ventricle, or if there be any impediment to the pulmonary circulation, either from disease in the vessels of the lungs, or from a change in the structure of a portion of the lungs, under any of these circumstances there are alterations in the pulse, some of which changes are so remarkable as to be sufficiently characteristic of particular diseases of the heart.

Alterations in the pulse very numerous.

On comparing the number of sensible changes in the pulse which authors have described with an enumeration of the diseased sounds of the heart, we are struck with the much greater number in those of the pulse; so that if both alterations in the heart's impulse and sounds and changes in the pulse assist materially in establishing the diagnosis of diseases of the circulation, and serve as indications for their treatment, those which are presented by the arterial pulse certainly afford by far the most abundant signs.

Pulse not altered in all affections of the heart.

It is of consequence, however, in considering this matter, to recollect what has been already mentioned—that diseases of the heart may sometimes exist without any apparent change in the arterial pulse, though we seldom find that the pulse is changed without a corresponding deviation in the action of the heart. Thus, when the heart's action is violently increased, as takes place in a thoracic aneurism, the great increase in the impulse which the heart acquires does not affect the arterial pulse, but is lost, or, as it were, destroyed, in overcoming the resistance which the aneurism causes to the circulation. And it may be stated, as a general observation, that in congestion and in all cases where the heart's impulse is increased in order to overcome an obstruction to the circulation, the increased impulse will not necessarily affect the arterial pulse.

This apparent discrepancy in the actions of the heart and the indications afforded by the arterial pulse is remarkable when the aortic valves are diseased or when the calibre of that artery is diminished, though the heart is compelled to act with an increased vigour to overcome such obstructions to the free circulation of the blood, yet the force of the arterial pulse is diminished; and I shall afterwards have occasion more fully to explain how in some diseases of the heart, particularly when there is a preternatural quantity of blood or congestion, the pulse is by no means a safe guide for the employment of bloodletting. Indeed, the difference in the cardiac and arterial pulses is often very remarkable.

In order to show how extensive are the variations of the arterial pulse, and with what nicety they have been discriminated, I have drawn up a table of such varieties as have been defined and characterised by distinct terms. At the same time it may be observed that in several instances these terms are nearly synonymous.*

By bringing together these various denominations of the arterial pulse, the importance of distinguishing them from one another will be the more apparent, whilst it will also show how difficult it is, and what extended observation it must require, to be able to recognise all these variations, and draw the practical as well as pathological conclusions that each may warrant. It is just as difficult to discriminate by the sense of touch all those nicer shades of difference in the arterial pulse as the eye, the ear, or the tongue to perceive slight differences in the qualities of bodies which are discernible by these several senses. Indeed, both experience and habits of accurate observation are requisite to enable us to detect the more minute changes to which the arterial pulse is liable, and refer each to particular conditions of the circulation; and this will account in some measure for the contradictory descriptions which have been given of the arterial pulse in the same diseases by different authors.

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* TABLE.

TERMS BY WHICH THE VARIETIES OF THE ARTERIAL PULSE HAVE BEEN DESIGNATED.

Full,
Voluminous,
Strong,
Incompressible,
Wiry,
Hard,
Tense,
Thready,
Contracted,
Firm,
Oppressed,
Small,

Elastic,
Bounding,
Sharp,
Fluttering,
Thrilling,
Quivering,
Vibratory,
Jerking,
Undulatory,
Unequal,
Irregular,
Intermitting,

Frequent,
Rapid,
Quick,
Accelerated,
Slow,
Feeble,
Soft,
Weak,
Faltering,
Languid,
Compressible.

We should likewise be aware, and I may here repeat, that observations on the arterial pulse, however accurate, serve comparatively little purpose in the diagnosis, and, as a guide in the treatment of diseases of the heart, unless when they are viewed conjointly with those changes in the other systems of the economy which usually accompany these affections.

Some functions of arteries are unchanged by disorders of the heart.

It is, too, of importance to keep in mind, when investigating this branch of semiology, that there are some functions of the arterial system which either may or may not be influenced by a disordered heart—functions which are performed alone by the arteries

When speaking of the functions of the arterial system, it was remarked that, after the blood is impelled from the left heart into the arteries, these vessels are employed not merely as simple tubes for conveying the blood to the different organs of the body, but, by virtue of peculiarities in their arrangement, the circulation in them undergoes almost endless modifications before the blood reaches its destinations. It may, indeed, be said that every organ—nay every subdivision or lobe of which an organ is composed—has its own special circulation; and the circulation in every organ is changed during every muscular movement.

These modifications are effected by differences in the lengths of the arterial trunks—by differences in the calibre of the branches, compared with the trunks from which they arise—by differences in the angle at which they arise from the trunk—by differences in their course, whether straight or tortuous—by their anastomosis—by differences in their modes of ramifying in the various organs, and likewise by vital causes. For it is by the influence of the nervous system that we can explain the sudden derivation of blood from the brain to the stomach by the presence of food, the repletion of the erectile tissues in the genital organs from venereal excitement, and the flushing of the face from mental emotions.

Functions of the arteries alone affected.

These powers, which arteries possess independent of the heart, are also exemplified in disease. What can be more striking than the increase in the size, and in the apparent vigour, in a temporal artery of a person suffering from a common "bilious" headache, and where there is not the least disturbance in the general circulation; in the remarkable pulsation sometimes met with in the abdominal aorta, when there is no diseased structure in the coats of the artery; in the increased action of the arteries contiguous to an inflamed part, such as is observed in the digital arteries when a finger is affected with whitlow; and, likewise, in the still more remarkable functions which the collateral branches of an artery perform whenever the circulation through the trunk of the vessel has been prevented by a ligature?

Baillie.

From all these phenomena it cannot be doubted but that the arteries possess powers and perform functions which are independent of the heart; and, consequently, we may expect to find that changes will take place in the arterial pulse which do not indicate, and which are not accompanied, by any corresponding alteration in the functions of the left heart.

Changes take place in the heart alone.

On the other hand, changes may take place in the heart's functions which are not followed by changes in the action of the arteries. If there be an excited heart, without any alteration in its structure, the arterial pulse will participate in its increased movements; but when the heart's action is increased, and if there be at the same time a change of its structure, then the arterial pulse will be diminished in force; for the action of the heart is increased in order to overcome some mechanical obstruction to the expulsion of the blood from the heart; and in proportion as the obstruction is great so will the heart's action be vigorous, and the pulse be in like proportion feeble. It would be just as pro bable that a person who, by making a violent effort to evacuate the bladder when there was an obstruction in the urethra, would be able to expel their contents with a proportionably increased force; instead of which, the violence of the effort being caused by the obstruction which is to be overcome, the stream of the urine will be effected more feebly.

Andral.

"There are a great number of cases where the heart is severely affected, and where there is little change in the pulse." This is almost constantly the case where the right heart is alone affected, and frequently when there is disease of the left heart. Hence the general principle, that, though the arterial pulse presents its natural characters, it must not be concluded that the heart is exempt from disease.

Importance of distinguishing differences in the arterial pulse.

Experienced practical men are more or less familiar with the numerous varieties in the arterial pulse, and, without being able satisfactorily to explain the pathological condition of the circulating apparatus in each of its varied changes, they have, nevertheless, along with the symptoms derived from the other systems of the economy, generally found them to be safe guides for regulating the treatment of disease.

This nicety in discriminating the less sensible changes in the arterial pulse has been, however, disputed by some eminent pathologists.

Speaking of William Hunter, John Hunter remarks that, "though he was extremely accurate in most things, he could never feel that nice distinction in the pulse that many others did, and suspected none such nicety of discriminating them can really be found. I think I have been certain of the pulse having a disagreeable jar in it when others could not perceive it—when they are only sensible of its frequency and strength." This observation is strictly true; for not only is a lengthened tuition required to enable a person to discriminate the varieties of the arterial pulse, but, as it is with all the other senses, that of touch is possessed in various degrees of acuteness by different individuals.

The varieties of the arterial pulse must be the effect either of differences in the vigour of the heart, of changes in the structure of some of its component parts, of changes in its functions, of differences in the quantity of the blood contained within its cavities, of changes in the qualities of the blood, or of vital causes.

These different changes produce alterations in the *frequency*, in the *force*, and in the *regularity* of the pulse.

Changes in the frequency of the arterial pulse;

In its *frequency* the arterial pulse is liable to great alterations in disorders of the heart.

its frequency increased;

The presence of food in the stomach, the slightest bodily exertion or mental excitement, accelerates the arterial pulse; and in some diseases its frequency is much increased, particularly in maladies of an inflammatory character, such as those wherein the lining membrane of the heart is inflamed.

There is, also, a great increase in the frequency, as well as changes in other qualities, of the arterial pulse from the loss of blood, whether it has been abstracted artificially or by a spontaneous hemorrhage. So much, indeed, are the beatings of the arterial pulse sometimes increased in frequency, that it is found impossible to count them accurately, and, notwithstanding the assertions of some, it is seldom found that more than 150 pulsations in a minute can be accurately discriminated.

Its frequency diminished.

In other diseases of the heart, especially those of a chronic nature, the frequency of the beats of the arterial pulse is very much diminished. We are told of persons in whom the arterial pulse did not exceed sixteen, and even ten, beats in a minute; but in such instances it is probable that all the pulsations of the heart were not sufficiently strong to be recognised in the arterial pulse.

Case recorded by Dr. Gould, of Boston.

A workman drank some cold water when overheated, and the effect on the circulation was to render the arterial pulse feeble, and reduce the pulsations to thirty-five in a minute; but on relieving the congested heart by bloodletting the natural action of the heart and arteries was restored.

Case recorded by Dr. Mason Good.

In another case a person who had a diseased heart which was occasioned by a fit of *asphyxia*, brought on by breathing the impure air from the bursting of a gas-pipe, the pulse never exceeded thirty beats in a minute.

Case recorded by Morgagni.

In an old man who had been attacked with epileptic paroxysms "I found such a variety of pulse that within the sixtieth part of an hour the pulsations were only twenty-two —that is to say, they were in number about two-thirds less than they ought to be, and this had been so already for many months."

Changes in the force of the pulse.

In its *force*, the alterations of the arterial pulse in disorders of the heart are numerous.

The *strong* and the *feeble*, the *full* and the *soft* are qualities of the arterial pulse which are commensurate with the vigour of the heart, and which conditions of the heart will always be characteristic of the state of the body generally, indicating its weakness and its strength.

The *incompressible* and the *compressible* pulse denote either a vigorous or a comparatively feeble state of the heart: the incompressible, wiry, or thready pulse being characteristic of some active inflammatory action; whereas the compressible, soft pulse is a symptom of a natural state of the circulation.

The *hard*, the *firm*, and the *tense*, the *wiry* and the *thready*, the *contracted* and the *oppressed*, are all terms in common use to signify particular qualities and minute shades of differences in the pulse.

A wiry, a vibratory, and a thrilling pulse have been supposed by John Hunter and Fordyce to depend upon the state of the *arteries*, and not upon that of the *heart*, or on the quantity of blood circulating through the arteries.

"A hard pulse," observes Haller, "denotes some obstacle or stimulus, or increased action of the heart, with a greater thickness of blood, or a greater rigidity or obstruction of the artery. A full pulse is caused by the fulness of the artery, joined with a strong force of the heart; and a *small* pulse by the emptiness of the artery and a smaller wave of blood sent from the heart."

A *quick* and a *frequent* pulse are not synonymous terms when applied to the pulse; for, whilst frequency implies merely the increased number of the beats without signifying the quality of them, by quickness is meant a peculiar quality of the beats. The frequency of the pulse may be increased by an increase in the vigour of the heart and a corresponding increase in the velocity of the arterial stream, whilst a quick arterial pulse arises from the heart being unable to propel the blood with its proper force and in its proper quantity; and, therefore, a small quantity only of blood being sent into the arteries by each ventricular contraction, the number of beats is thus increased.

There are other varieties of the arterial pulse, all of which depend upon a diminution in the vigour of the heart's action. Of this description are the *quick* and the *rapid*, the *elastic*, the *bounding*, the *vibratory*, the *fluttering*, and the *languid*, the *jerking*, and the *undulatory* pulse.

The effects of spontaneous hemorrhages and of profuse bloodletting upon the arterial pulse not only increase its frequency, but at the same time cause in it a vibratory or undulating sensation; and the depressing passions, by producing congestion of the heart, are followed by a great diminution in the force as well as in the frequency of the arterial pulse.

Changes in its rhythm.

The arterial pulse may become *irregular* either from a disease in the structure of the heart, or from a disturbance of its functions; and there is no more common sign of a disordered heart than an irregular or *intermitting* pulse.

The radial pulse is generally examined from its representing the number of the heart's contractions; but when the heart acts very feebly each of its pulsations may not reach the radial artery, or, when the heart's contractions are unequal in force, some may be propagated to the wrist, and others may not be recognisable to it—thus causing the pulse to intermit.

Abernethy, who ultimately perished from a disease in his heart, which had commenced in early life, in narrating his

Abernethy's Lectures.

own case observed—"When I laid down in bed of a night my heart intermitted to such an extent that I thought it never would beat again; then it would go on with the utmost vehemence for a time; but as the anxiety of my mind subsided, so this state went off."

There is an irregularity of the pulse in which a great variation in its frequency takes place at different times of the same day. "In one patient, who had much dyspnœa with delirium, the pulse beat only thirty times in a minute, and some time after sixty times. In other instances the pulse varied exceedingly on different days, and without any evident cause."

Andral.

Irregularities of the pulse from medicines.

These differences in the daily beats of the pulse ought to be taken into consideration when we are watching the effects of certain medicines, especially of *digitalis,* for effects have been often attributed to that medicine in lowering or quickening the pulse which do not belong to it.

The arterial pulse has been observed to be irregular or intermittent during health, and become regular during acute disease, and return to its former condition during convalescence.

Some of the peculiarities of the arterial pulse.

Besides changes in its frequency, vigour, and regularity, there are other peculiarities of the arterial pulse which merit consideration.

See page 206.

It has already been remarked that the cardiac and arterial pulse do not always correspond in strength in some of the diseases of the heart. Changes may take place in the action of the heart which are not accompanied by any change in the arterial pulse. If there be an excited heart, without any alteration in its structure, the arterial pulse may participate in its increased movements; but when, besides the increased action of the heart, there is an alteration of its structure, then the vigour of the arterial pulse will be diminished; for the increased action of the heart being required to overcome some mechanical resistance to the expulsion of the blood from the heart, hence it follows that, in proportion as the obstruction is great, so will the heart's action be increased, and thus the arterial pulse will become proportionably feeble.

Hence it may be inferred from the foregoing remarks, that when the action of the heart is increased, and there is a corresponding increase in the arterial pulse, the heart's structure will probably be sound; but, on the other hand, if the action of the heart is increased, and there is no corresponding increase in the arterial pulse, but rather a diminution in its vigour, then it is equally probable that there will be some change in the structure of the heart.

It sometimes, though rarely, happens that the arterial pulse is much less frequent than the pulse of the heart. Andral has mentioned a case in which "for thirty or forty beats of the artery there were one hundred and twenty of the heart;" and a remarkable instance is recorded by Reil, in which "the heart and the carotid and radial arteries all pulsated differently." **Cases.**

"In a young man who fell from a tree and bruised his back, and who suffered from a continued palpitation of the heart for nine years, I found the pulse in both the wrists unequal and irregular, yet in such a manner that it was manifest, when I attended to the greater part of the pulsations, that in the left wrist they could neither be called rare nor frequent, and that in the right they were almost three times more rare than in the left." **Case recorded by Morgagni.**

In some affections of the heart I have observed a remarkable *inequality* in the beats of the pulse.

"A vibration or tensity of the pulse was, soon after, joined, and so great a celerity that, although both motions of the artery—that is, outwards and inwards—did not take up, when taken together, much more time than they generally do when in a natural state, yet the first was three times shorter than the second." **Case.**

Morgagni.

It sometimes happens that the radial pulse is different in the two arms. **The pulse differs in the two arms.**

"One of the most remarkable characters which the pulse presents in diseases of the heart is that it is different in the two arms—or is perceptible in the one, and not to be recognised in the other, arm."

Corvisart.

Cases.

Parry observed three cases of this kind. In a lady, who was of an arthritic diathesis, and whose heart was irritable, I remarked that the pulse in one arm had disappeared, but in six months it was again perceptible.

Bordeau and others.

Though the observations which have been made on the arterial pulse all relate to the varied conditions of the central organ itself, and are intended to point out the changes in its functions as a simple machine or forcing-pump, yet I may allude to the differences in the pulse observed in diseases of different organs, of which much has been said by the older writers; such differences arising, no doubt, from that relation and sympathy which subsist between the various organs of the economy. And, although such a system of diagnosis may have been unwarrantably extended, yet it is universally admitted that in some diseases, such as enteritis, rheumatism, and carditis, the character of the pulse in each organ, when inflamed, is perfectly different.

Before concluding these observations on the arterial pulse, it is essential to bear in mind, when examining the condition of the circulation, the natural differences of the pulse of persons at the different periods of life, at different times of the day, at different seasons of the year, and in the different states of the atmosphere.

Other differences in the pulse.

The changes in the pulse from alterations in the posture of the body are likewise of consequence to be noticed. The pulse of a healthy person, which beats sixty times in a minute when he is in a horizontal posture, will generally beat sixty-eight or seventy times in a minute when in the erect posture: a difference which appears to be most satisfactorily accounted for by the heart being able to impel the blood throughout the system with much less force in the horizontal position of the body than when it has to combat against the weight of the superincumbent column of all the blood in the upper part of the body when a person is erect.

The influence of *medicinal* substances, too, upon the arterial pulse must never be lost sight of, and be taken into consideration in the examination of diseases. Narcotics have the effect of altering the pulse, and hence it is that digatalis, belladonna, hyosciamus, opium, prussic acid, and the plants containing it, are all made use of in the treatment of diseases of the circulation, from the influence which such substances have upon the action of the heart.

The changes which take place in the pulse in many diseases of all the organs of the body prove how great is their sympathy with the heart, and how disorders of the heart cause in their turn various derangements throughout the system; and thus it is that the arterial pulse is not only examined to inform us of the condition of the heart, but the condition of the heart tells us the state of the organ where the primary disease exists. When, therefore, a person suffering from some local inflammation or injury has the arterial pulse changed, we do not always direct remedies to the heart, but to the affected part, and by alleviating which the heart is tranquillised.

Symptoms derived from the Venous System.

In like manner as in diseases of the left heart the arterial circulation undergoes certain changes, so we find that the *venous* circulation is changed in diseases of the *right* heart; and these changes which take place in the venous system afford *symptoms* which are as characteristic of disturbances of the pulmonic heart as those of the arterial system indicate disorders of the systemic heart. **See page 61.**

I have formerly endeavoured to demonstrate that, when both the hearts' cavities and the pulmonary vessels become gorged with blood, the subcutaneous veins and those also of the internal viscera, then receive such superabundant blood as the heart and pulmonary vessels cannot admit, and retain it in their turn until the balance of the thoracic circulation is restored. Hence, we may anticipate that when the right heart becomes permanently congested, as often takes place in diseases, there will be a corresponding congestion in the venous system.

Venous congestion may be more or less general in diseases of the heart, either extending throughout the whole of the *subcutaneous* veins, or confined chiefly to the veins of the *cerebro-spinal*, *respiratory*, or *portal* systems.

Venous congestion of the cerebro-spinal system.
See page 168.

In the *cerebro-spinal* system venous congestion produces those remarkable changes which have been already mentioned when discussing the symptoms in disorders of the heart which are derived from disturbances in that system. The languor and aberration of the intellectual powers, and the diminished vigour of the organs of active motion, are very remarkable symptoms, which are caused by venous congestion in the cerebro-spinal system.

Congestion of the respiratory system.

Congestion of the right heart produces effects upon the *respiratory* organs no less remarkable. Cough, dyspnœa, and asthma must be the necessary consequences of veno-pulmonary congestion. The cough is dry and hard, and comes on in paroxysms, which endure for a longer or shorter period, and sometimes terminate in profuse perspiration, nausea, and vomiting. The embarrassment in breathing is constant, though greatly aggravated by any muscular exertion, by an over-distended stomach, or by the *primæ viæ* being deranged.

"In the diseases of the heart the difficulty in breathing may arise from mechanical pressure upon the lungs, from an increase in the bulk of the heart, or from the growth of an aneurismal tumour; that is true in some cases, but, in the greater number, it appears that the difficulty in respiration is caused solely by the accumulation of blood in the vascular system of the lungs, in consequence of the difficulty it meets with in entering into the cavities of the heart, the structure of which has been changed."

Corvisart.

Congestion of the portal system.

The effects of the congested state of the right heart are equally evident upon the *portal* system, and hence arise an assemblage of *symptoms* in diseases of the heart which are caused by disorders of the chylopoetic viscera.

In consequence of congestion of the right heart the blood of the inferior cava vein must meet with a difficulty in flowing into the right auricle, so that the functions and even the structure of the *liver* undergo particular alterations by the changes in the circulation.

"In almost every disease of the heart," observes Corvisart, "the liver becomes the seat of an engorgement of blood, which I have often observed in the dead body, and which gives to this viscus, especially in the advanced stage of these diseases, an unnatural bulk. Indeed, it is easy to feel this tumefaction through the abdominal parietes; it sometimes becomes so considerable that the margin of the liver passes considerably beyond the edge of the ribs, whilst its convexity, pressing the diaphragm and mounting up the right cavity of the thorax, prevents the inferior region resounding by percussion."

Corvisart, page 443.

Congestion of the subcutaneous veins.

And in the *subcutaneous* veins the congested state of the right heart causes manifest changes, especially in the veins of the head, face, and neck, these vessels becoming more or less varicose, and their smaller branches so distended as to give the skin a livid colour, which is sometimes so intense as to amount to a deep blue.

This appearance of the veins, along with more or less *œdema*, with which it is accompanied, may be considered as a symptom pathognomonic of some affection of the right heart.

The morbus cœruleus.

The livid colour of the skin which is produced by venous congestion differs materially from the blue appearance of the integuments which is caused by an admixture of the arterial and venous blood in the heart. In the first case the livid colour arises from an absolute increase in the number and bulk of the cutaneous veins, whereas the blue colour produced from an admixture of venous with arterial blood is not accompanied with any increase in the number or size either of the venous, arterial, or capillary systems.

Besides, the blue colour from venous congestion does not appear over the whole cutaneous surface, but only in particular parts; whereas in the "blue disease" of the ancients the whole skin is discoloured, the mass of blood having acquired a new colour from an admixture of the arterial and venous blood.

The venous pulse.

The *venous pulse* is also a symptom of a disordered heart; for, when the escape of the blood from the right ventricle into the pulmonary artery is impeded, the regurgitation of the venous blood into the auricle, and from the auricle into the cavæ veins, is increased, and hence arises the pulsation, and which is often observed to be so remarkable in the jugular veins.

Symptoms derived from the Capillary System.

The capillary system of vessels perform all the important functions of secretion and of excretion; whereas the heart, with its arteries and veins, though under the influence of the nervous system, is a pure mechanical apparatus employed for conveying the blood to the different organs, and receiving it, after the necessary secretions and excretions have been made, in order that it may be replenished with chyle prepared by the digestive apparatus, and again oxygenated by the organs of respiration.

The functions of the capillaries, as well as the phenomena which they manifest in diseases, point them out as a distinct system of vessels intermediate between the arteries and the veins, and, though intimately related to, and under the influence of, the heart, they are yet independent of its actions further than by receiving from it the necessary supply of blood.

To execute their various functions, the capillaries present different structures and arrangements in the different organs, by all which, under the immediate influence and control of the nervous power, they form a *vital* laboratory in which are compounded and separated from the blood those elements which are necessary for the life and growth of the living being.

As it has been already pointed out that disturbances in the functions of the capillary system produce changes in the action of the heart, so we shall find that in affections of the heart the functions of the capillaries are more or less disturbed,—disturbances which constitute an important class of *symptoms* in the heart's diseases.

Indeed, the two portions of the sanguineous system—the heart and the capillaries—are so intimately associated in all their functions, it is but seldom observed either in acute or in chronic diseases that there is any serious disorder of the one without some corresponding change in the functions of the other.

"The *general* circulation is not always so much changed in diseases of the heart as the capillary circulation." Laennec.

This influence which the capillaries exercise upon the heart, and which the heart in its turn exercises upon the capillaries, is exemplified by many pathological phenomena, and observed chiefly in those of the cutaneous and gastro-pulmonary mucous system.

The most remarkable of these symptoms in disorders of the heart—which are derived from changes in the functions of the *cutaneous* capillaries—are paleness and flushing, coldness and heat, dryness and moisture,—some of which phenomena appear to appertain chiefly to the arterial, and others to the venous, system,—the one being caused by disturbances of the systemic, and the other by disorders of the pulmonic, heart.

Sometimes, as when the action of the heart is increased during mental excitement, the capillary system of vessels is overloaded with blood, and the skin becomes redder and warmer than natural, and sometimes, as in congestion of the heart caused by grief, the skin becomes pale and cold, accompanied by shiverings. Sometimes there is a dry, arid, and parched state of the cutaneous surface, and sometimes there are profuse and cold perspirations.

In no disease is this influence of the heart upon the capillary system more distinctly shown on the cutaneous capillaries than in a *febrile* paroxysm, by its cold, hot, and sweating stages; and on the capillaries of the mucous membrane of the digestive canal, by the dryness of the mouth and excessive thirst: all which conditions of the capillary system may be considered as *symptoms* of disorders of the heart.

"He had a *fever* when he was in Spain,
And when the fit was on him I did mark
How he did *shake*; 'tis true, this god did shake;
His coward lips did from their *colour* fly;
And that same eye, whose bend doth awe the world,
Did lose its lustre. I did hear him groan;
Ay, and that *tongue* of his that bad the Romans
Mark him, and write his speeches in their books,
Alas! it cried, 'Give me some *drink*!'"—SHAKSPERE.

There is no more striking symptom in affections of the heart indicated by changes in the cutaneous capillaries than a sensation of *coldness*, more especially of the hands and feet, though sometimes extending over the whole cutaneous surface, such effects being caused by a diminution of blood in the capillary system.

Case. The coldness of the feet and limbs from *pulmo-cardiac congestion* was instantly and permanently relieved in a young lady whilst leeches were applied to the cardiac region.

Accompanying coldness there is always more or less paleness, or the skin may be of a livid colour: in the first case the blood, both in the arterial and venous capillaries, being diminished, whilst in the latter there is a congestion of blood in the venous capillaries. The coldness of the cutaneous surface is often accompanied with *shivering*, and these conditions are often the prelude of those *fits* which are caused by a disordered circulation.

Case. A youth who had for many years suffered from a disease of his heart, and one of the most prominent symptoms of which he complained was a painful sense of coldness of the hands and feet, and these were swollen, and of a deep livid hue. The state of the heart being greatly improved, the amendment was strikingly marked by a return of the natural heat and pallid colour of the hands.

A hot, an arid, or parched state of the cutaneous surface is frequently observed in a disordered circulation, and is accompanied with a corresponding redness or flushing of particular portions, such as that of the face and of the hands and feet.

Perspiration, more or less profuse, occurring in diseases of the heart is generally accompanied by coldness of the skin.

A lady was completely relieved of her difficult breathing, Case. and other symptoms accompanying a disordered heart, of long duration, after a profuse *perspiration*—strikingly exemplifying the connection between the heart and cutaneous capillaries.

The capillaries of the gastro-pulmonary *mucous* membrane are no less under the influence of the action of the heart than those of the cutaneous system, and all the changes which it undergoes assist us in forming a correct diagnosis of the condition of the heart.

I have already mentioned the remarkable effects on the functions of the heart which are produced by the application of cold or heat upon the mucous system; and, on the other hand, we find remarkable changes in the functions of the capillaries in diseases of the heart.

In acute diseases of the heart accompanied with fever we observe how greatly the mucous surface of the alimentary canal is influenced, and its functions disturbed, in like manner as has been remarked of those of the external skin. The mouth becomes parched and dry, causing thirst; and that portion of the membrane covering the tongue becomes thickened, its colour is altered, and a milky-coloured mucus is secreted from, and deposited on, its surface.

This state of the mucous membrane of the mouth is accompanied with a corresponding change in the functions of the stomach. The appetite is impaired and the powers of digestion of solid food cease, and, where an opportunity was obtained of *seeing* into the stomach, its interior surface was pale and dry. Case of Martin, the Canadian.

The desire to drink, the *thirst*, which those experience who are suffering from febrile diseases, seems to be an instinctive appetite to supply the body with liquids necessary when in this state of fever, as hunger causes an appetite for food when the system requires to be replenished.

In the *chronic* diseases of the left heart we seldom observe any symptoms of affections of the stomach; but in diseases of the right heart, the digestive apparatus is more or less influenced and deranged, especially the chylopoetic viscera.

When inquiring into the symptoms in diseases of the heart derived from the respiratory organs, I have mentioned that a *spontaneous* bleeding from the pulmonary mucous surface is one of the most unequivocal symptoms; hemorrhage, however, does not always take place from that portion of the mucous surface, or from the Sneiderian membrane, but also from particular portions of the mucous membrane of the intestinal canal; hence the vomiting of blood and the hemorrhoidal flux, both of which we shall more particularly consider when treating of the symptoms derived from the digestive organs.

Œdema.

A *serous effusion* into the cellular tissue, like most other symptoms of a diseased heart, takes place in every possible degree, though it often escapes observation until the more advanced stages.

I have usually found that in all cases where the circulation has been disturbed, even for a very short period, that the face becomes puffy, leading those around the sufferer to consider him comparatively in health and "getting fatter." One or both feet at the same time begin to swell from the infiltration; and, as the organic changes in the heart's structure advance, symptoms supervene which show that the pericardium and cavities of the pleura have become more or less distended with serum.

Here I may allude to a pathological observation of the ingenious Bichat, that œdema appears only *after* effusion has taken place in the serous cavities which immediately surround the diseased organ; so that, when affections of the heart are accompanied with œdema, we may infer that a corresponding effusion has already taken place in the pericardium; and when the effusion takes place within a serous cavity, in consequence of some disease of the organs unconnected with the membrane, the serosity is limpid, transparent, such as that which circulates in the lymphatic vessels. But, when the hydropsy depends upon a disease of the serous surface itself, the collected serosity is then changed, becoming milky, and having fleaks of albumen deposited upon its surface.

Anatomie Générale.

From this observation we may infer that, in diseases of the heart, those of the pericardium are accompanied with effusion of serum, as well as with lymphy depositions, but those of the cavities and their lining membrane, when accompanied with effusion into the pericardium, that effusion is limpid and purely serous.

Towards the fatal termination of diseases of the heart I have, in a few instances, observed that the serous effusion is diminished, and in two cases where there had been universal anasarca, the swelling of the limbs suddenly and completely disappeared a few days before death.

Change in colour in the hair.

The changes which are produced by disturbances of the heart upon the cutaneous capillaries are illustrated in a remarkable manner in persons where the *hair* of the head has suddenly become *white* from a disturbance in the heart caused by violent mental excitement.

Case communicated by Mr. Faxon.

"A lady who was deeply grieved on receiving the intelligence of a great change in her worldly condition, and who had a very remarkable quantity of dark hair, on the following morning the whole of the hair had become of a silver white."

> "My hair turned white
> In a single night,
> Like some have done
> With sudden fears."—Byron.

Some striking instances of this kind are narrated by historians.

"I was struck," says Madame Campan, "with the astonishing change misfortune had brought upon Maria Antoinette's features: her whole head of hair had turned almost *white* during her transit from Varennes to Paris."

The Duchess of Luxembourg, when caught making her escape during the terrors of the French revolution, and put in prison, the next morning it was observed that her hair had become *white*.

A Spanish officer, distinguished for his bravery, was in the

Duke of Alva's camp, and an experiment was made by one of the authorities to test his courage. At midnight the provost-marshal, accompanied by his guard and a confessor, awoke him from his sleep, informing him that, by order of the viceroy, he was to be immediately executed, and that he had only a quarter of an hour left to make his peace with Heaven. After he had confessed, he said that he was prepared for death, but declared his innocence. The provost-marshal at this moment burst into a fit of laughter, and told him that they merely wanted to try his courage! Placing his hand upon his heart, and, with a ghastly paleness, he ordered the provost out of his tent, observing, that he had "done him an evil office;" and the next morning, to the wonder of the whole army, the hair of his head, from having been of a deep *black* colour, had become perfectly *white!* Russell's Letters.

CHAPTER XI.

SYMPTOMS OF DISEASES OF THE HEART DERIVED FROM THE DIGESTIVE SYSTEM.

Connection of the heart with the organs of digestion; symptoms derived from disorders of the stomach; nausea; sickness; vomiting; vomiting of blood; discharge of blood from the rectum; symptoms derived from the bi'iary organs.—Conclusion.

ALTHOUGH it has been from amongst the phenomena in the cerebral, respiratory, and vascular systems, where we have sought for the most remarkable *symptoms* in the disorders of the heart, there are, nevertheless, other systems which are deranged in these affections, and from which symptoms equally important, though not so numerous, may be derived.

When alluding to the reciprocal influence of the heart and digestive organs, I have remarked how much the functions of the heart were under their influence, how frequently disorders of the digestive organs disturb the functions of the heart, and how these symptoms may arise either from disturbances in the functions of the stomach, of the intestinal canal, or of the biliary organs. See page 81.

Symptoms derived from the stomach.

Though the stomach may be, according to Hunter, considered as the seat of "universal sympathy," and that many of its diseases exercise a great influence upon the circulation, yet we shall find that the heart, when disordered, does not, in its turn, cause so frequently disturbances in the stomach. Indeed, the relation between the stomach and the heart is quite of a different character from the relation of the heart with the respiratory and cerebro-spinal systems. The intimate relation of the lungs and the brain with the heart I have endeavoured to show depends upon the *blood*; whereas the consent between the heart and the stomach depends entirely upon the *nervous* system. See page 83.

Of the symptoms in disorders of the heart derived from derangements of the stomach the most remarkable are nausea, sickness, vomiting, and hemorrhagy.

Vomiting.

I have already endeavoured to point out that *vomiting* is one of those instinctive acts of the economy—indeed, a striking example of the *vis medicatrix*—which is resorted to for the purpose of restoring the balance of a disturbance of the thoracic circulation; and the disorders of the heart wherein vomiting occurs may arise from different causes, such as syncope, hysterical and epileptic paroxysms, mental excitement, the unaccustomed motion of turning round rapidly, or sailing in a ship. It is for the purpose of restoring a disturbed circulation that vomiting takes place in the different states of the system which I have just now enumerated, and in each of which the functions of the heart are deranged, so that vomiting must form an essential *symptom*, though it has not, as far as I know, been noticed as such by any of those authors who have treated of the semiology of the heart.

It must, at the same time, be remembered that vomiting may arise from other causes besides a disordered heart. The presence of noxious food, the passage of a renal calculus through the ureter, of a biliary calculus into the duodenum, a pregnant uterus, or a portion of intestine which is strangulated, are all accompanied by *vomiting*.

Case.

A youth complained of a sense of nausea, and sometimes vomiting, with which he had been afflicted every morning for several months. He had no symptom of derangement in any of the digestive organs, and my attention was directed to an examination of the circulation. The radial pulse was small, contracted, and of natural frequency; but the heart's impulse was greatly increased. Leeches were applied to the precordial region, and, notwithstanding the condition of the stomach, a quarter of a grain of the tartrate of antimony was given twice a day; by which treatment the disorder of the heart was relieved, and the sickness never returned. Hence we find that some patients with disorders of the heart are relieved, whilst others may suffer from accidental vomiting.

An emetic may often be had recourse to with advantage for restoring a disturbed circulation; and there are some with a disease of the heart who suffer very severely from sea-sickness, whilst healthy people who are sea-sick experience temporary relief from the act of vomiting. Hence may be accounted for the good effects of artificial vomiting in some *coughs*, which may be deemed an indication that the cough in such cases had been depending upon a disturbance in the action of the heart. Page 193.

And, indeed, whenever nausea or vomiting is observed without any other symptom of digestive derangement, or any symptom which would lead to the suspicion of the head being the seat of disease, of a stone passing along the biliary ducts or ureter, we may then conclude that some disorder of the *heart* is the cause of the vomiting; whilst, on the other hand, whenever nausea and vomiting occur accompanied with the ordinary signs of cerebral, biliary, or digestive derangement, then we may conclude that they are not caused by, or symptomatic of, a disturbed heart.

Nausea with vomiting;

Though there may be vomiting without nausea, or nausea without vomiting, yet they are generally linked together, forming, as it were, two distinct stages of one act; and the condition of the circulation appears to be so different in the two stages that at first sight the sensible effects of each upon the system seems quite incompatible with their performing conjointly only one office in the economy. In a pathological point of view it is necessary to consider them separately.

Nausea greatly lowers the action of the heart and diminishes the powers of life. Antimonials, by the nausea which they produce, are therefore employed to diminish the vigour of the circulation in inflammatory diseases, and are successfully administered either singly or in conjunction with blood-letting, the effects of nausea and the abstraction of the vital fluid upon the heart being equivalent.

The act of *vomiting*, on the other hand, appears to be purely mechanical, the abdominal muscles and diaphragm squeezing the stomach and evacuating its contents, propelling the venous blood to the right heart, and impeding the flow of the blood in the great arterial trunks.

their effects explained.

Such being the differences in the effects of nausea and

Vomiting.

I have already endeavoured to point out that *vomiting* is one of those instinctive acts of the economy—indeed, a striking example of the *vis medicatrix*—which is resorted to for the purpose of restoring the balance of a disturbance of the thoracic circulation; and the disorders of the heart wherein vomiting occurs may arise from different causes, such as syncope, hysterical and epileptic paroxysms, mental excitement, the unaccustomed motion of turning round rapidly, or sailing in a ship. It is for the purpose of restoring a disturbed circulation that vomiting takes place in the different states of the system which I have just now enumerated, and in each of which the functions of the heart are deranged, so that vomiting must form an essential *symptom*, though it has not, as far as I know, been noticed as such by any of those authors who have treated of the semiology of the heart.

It must, at the same time, be remembered that vomiting may arise from other causes besides a disordered heart. The presence of noxious food, the passage of a renal calculus through the ureter, of a biliary calculus into the duodenum, a pregnant uterus, or a portion of intestine which is strangulated, are all accompanied by *vomiting*.

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their effects explained.

Such being the differences in the effects of nausea and vomiting upon the circulation, we are naturally led to consider how they could be combined in order to perform what appears only to be one act of the economy. To me it seems probable that by *nausea* the action of the heart is so greatly diminished in vigour, and the velocity of the blood so much lessened, that the vomiting which succeeds is the better enabled, by its mechanical action on the heart and vascular system, to restore the balance of the circulation, than it would have been enabled to effect had the action of the heart been more vigorous, and had the stream of blood passing through its cavities flowed with greater velocity.

In corroboration of the nature and purposes of the two stages of this act, it may be remarked that the vomiting which is *preceded* by nausea is an instinctive act employed for restoring a disturbed circulation; whereas vomiting employed to evacuate the stomach of pernicious contents is *not* preceded by nausea, properly so called, but only by the sensation of *sickness*.

That there should be some wise purpose fulfilled by nausea and vomiting being thus combined and co-operating with one another to execute one particular act cannot be doubted; and by glancing over other acts of the economy we perceive that in some of these the same principle is resorted to, two processes apparently quite dissimilar being employed by the *vis medicatrix* in order to execute only one purpose. For instance, no two processes can be more dissimilar than syncope and that which is employed by nature to arrest the bleeding from a divided artery, and yet we find it requisite that, in order to fulfil this important purpose, both processes are necssary.

To arrest the hemorrhage, it is required that the mouth of the bleeding vessel be closed by a coagulum of blood; but to accomplish that process, and in order that the blood may the more speedily coagulate, it is also necessary that its momentum be greatly diminished; the first effect of the hemorrhage is to produce a fainting state, or syncope, by which the circulation becomes languid, and thus favours the formation of a coagulum.

Confirmatory of these views which I have offered on the nature of nausea and vomiting, I may allude to the difference in the effects which are produced by different *emetics,* those such as mustard, ipecacuanha, or tickling the pharynx, merely evacuating the stomach, whilst the tartrate of antimony, and others, besides producing *vomiting,* first cause a protracted *nausea.*

Whatever be the explanation offered of the phenomena of nausea and vomiting, practical men seem to be quite aware of the differences in the effects of these different kinds of emetics in the treatment of diseases, vomiting being employed merely as an evacuant, but nausea with vomiting is resorted to with a view to relieve the condition of the circulation in febrile disease, and in those where the functions of the heart are more immediately disordered. Thus, too, we may account for the different opinions that have been given of the effects of emetics in some diseases, such as in hemoptysis; in which we can readily understand how nausea with vomiting should relieve the hemorrhagy, and excessive vomiting without nausea increase the symptoms.

Sickness, I may remark, must not be confounded with nausea; the terms are not synonymous.

Sickness differs from nausea.

It appears to me that by nausea is understood that peculiar sensation which is felt in those disturbances of the action of the heart where vomiting is resorted to by the economy for restoring the circulation; whereas *sickness,* properly so called, only precedes the vomiting which is resorted to for the purpose of evacuating from the stomach offensive contents. Hence the two common expressions of "sickness at stomach" and "sickness at heart" are pathologically correct.

Vomiting of blood.

When inquiring into the symptoms in diseases of the heart derived from the respiratory organs, I have mentioned that a spontaneous bleeding from the pulmonary mucous surface is one of the unequivocal symptoms of a disordered heart; but this spontaneous hemorrhage does not take place in all disorders of the heart either from that portion of the gastro-pulmonary mucous surface of the lungs, or from the Sneiderian membrane, but also from particular portions of the mucous membrane of the intestinal canal,—and hence *vomiting* of blood and *intestinal* hemorrhagy.

Case.

A lady was deeply afflicted at the loss of her child, and in a few hours she was attacked with vomiting, which continued unabated for ten days, at which period she vomited a large quantity of blood; and the vomiting never returned, though she long afterwards suffered from a disordered heart.

Intestinal hemorrhage.

The *hemorrhoidal flux*, of which so much has been said by the older pathologists, is a frequent symptom of a disordered heart—more especially the pulmonic heart; for, whenever the inferior cava vein cannot readily empty its blood into the right vautricle, the whole portal system becomes congested, and an effort is made to relieve the system by the hemorrhoidal flux; in like manner as we have seen that cerebral congestion is relieved by epistaxis, and the pulmonary congestion by hemoptysis.

It is by this connection of the heart with the *portal* system by which we can satisfactorily explain the beneficial effects which have always been attributed to the loss of blood from the hemorrhoidal veins in congestion, not only of the right heart but of the cerebro-spinal and pulmonary systems; and of the important practical inference so universally established of the danger of employing means to arrest the hemorrhoidal flux,

Many are the cases where the most distressing symptoms, as apoplexy and hemoptysis, have arisen from the disturbance to the circulation which has been caused by the suppression of the hemorrhoidal flux.

See page 218.

From the observations that have been made on the morbid condition of the *liver*, and of the derangements in the portal system in those diseases especially which affect the right heart, *symptoms* will also be manifested in the chylopoetic viscera which will assist in pointing out the heart's condition.

Besides an engorgement of the portal system, the functions of the liver become deranged, and the quantity and quality of the bile variously altered; which changes in the biliary secretion, by their influence on the digestive process, cause derangements in the functions of the intestinal canal as well as in those of the kidneys.

These observations, however, will apply only to the disorders of the *right* heart; for as the arterial system of the abdominal viscera has no peculiarity in its arrangements, and, as there is no vascular distribution such as that subsisting between the portal system and the right heart, consequently we may anticipate that there will not be that connection in the diseases of the left heart with the digestive system which has been shown to subsist between that system and the right heart.

And this accords with all the observations that I have been able to make on the diseases of the two hearts; for in the various organic diseases of the *left* heart I have generally found that the state of the organs of digestion were, in most instances, uncommonly healthy, though, undoubtedly, a disease of the left heart may exist at the same time with a derangement of the *primæ viæ*.

This observation it is of importance to bear in mind when considering the diagnostic symptoms of organic disease of the heart. For whilst a deranged state either of the digestive or nervous system may produce sympathetic affections of the central organ, the absence of all derangement in either of these systems may be taken as a strong indication of the presence of some primary affection in the heart.

CHAPTER XII.

SYMPTOMS OF DISEASES OF THE HEART DERIVED FROM THE UTERINE SYSTEM.

Connection of the heart and uterus; its dependence upon the nervous system; suppressed menstruation; irregular and painful menstruation; cessation of the menstrual flux; uterine hemorrhage; physiological symptoms concluded.

Symptoms derived from the uterine system.

MUCH as the functions of the heart are influenced by those of the uterine system, in as great a degree is the uterine system influenced by disorders of the heart; and, like the stomach, this connection between the heart and the uterus entirely depends upon the nervous system.

The *symptoms* of diseases of the heart afforded by the uterine system are, however, few, because, except when the uterus is in the impregnated state, the only function which it performs is that of menstruation. The menstrual flux may either be increased or diminished, become irregular, or it may completely cease.

During all these changes in the uterine function we find the functions of the heart more or less disturbed, so that the condition of the uterus will be found in most instances to be the effect of some primary affection of the heart.

There is no more common symptom of a disordered heart in women than the non-appearance of the catemenia at the age of puberty.

Obstructed menstruation.

The great convulsion which takes place in the human frame at that eventful period of life renders it very susceptible of disease; and the mind being at the same time easily excited, and the passions less under control, it very frequently happens that the heart's functions are disturbed, and the uterine system more, perhaps, than any other, influenced by the disordered circulation, so much so, indeed, that sometimes the essential function of menstruation is never performed. In such cases the heart is usually more or less congested, and, the blood being imperfectly circulated in the different organs, these are, likewise, variously affected by the unequal supply which they receive of the vital fluid, some having too small, and others too large, a quantity for the performance of their healthy functions.

Irregular menstruation.

No less frequently do we find disorders of the heart accompanied by *irregularities* of the menstrual flux; these irregularities consisting of differences in the quantity and quality of the secreted fluid, and of differences in the periods of the accession and of the duration of the discharge.

The varied changes in the functions of menstruation most frequently accompany those changes in the heart's functions which are produced by moral causes; and, therefore, it is found that the remedial means which are most useful in restoring the uterine functions are those that have a specific effect upon the organs of circulation, a depletive system relieving an interrupted and diminished menstrual discharge, and the preparations of steel, zinc, and lead relieving uterine hemorrhage.

Menorrhagia.

Besides irregularities in the menstrual secretion, the mucous membrane of the uterus is liable to *hemorrhage*, and such spontaneous hemorrhages are often connected with a disordered heart; in many instances appearing to be resorted to by the economy in order to relieve congestion of the heart, in the same manner as we have seen that these affections are relieved by a spontaneous bleeding from different portions of the gastro-pulmonary mucous surface.

Such uterine hemorrhage may take place immediately after the cessation of the menstrual flux; it may accompany that secretion, the menstrual fluid being mixed with healthy blood; or the hemorrhage may occur at any time between the menstrual periods.

And in all these different derangements of this function we find that in many instances the action of the heart is deranged; and, as I have already mentioned, the remedies which are most useful in such disorders are chiefly those which act upon the heart.

Conclusion.

In accordance with the objects I have had in view, I have thus far endeavoured to arrange and explain the nature of the numerous symptoms which, in the diseases of the heart, are derived from the effects of a disturbed circulation upon the different systems of the economy.

And when it is considered that the function of the heart and its vessels is to convey throughout the whole system that vital element by a due supply of which alone can their functions be executed, it might have been anticipated that each of these systems of organs would be materially influenced and deranged whenever the heart with its vascular apparatus did not supply them with their requisite quantity of blood.

It might, too, have been anticipated that, in the maladies of the heart, not only one of these systems of the economy but that several, or all, of them might be simultaneously affected; so that the symptoms—the physiological symptoms—would be numerous, would form various assemblages, and be variously combined in the different diseases.

Contemplating these symptoms, and seeing how varied they are in their number and in their combinations, we might have also anticipated that particular symptoms and particular assemblages of symptoms would appertain to particular diseases. But, in prosecuting this field of inquiry, we meet with numerous difficulties, finding that many diseases which appear similar, as far as our knowledge enables us to judge, are attended with very dissimilar symptoms; and, likewise, that similar symptoms are met with in diseases which are of very different characters.

The only classification which can be made of the physiological symptoms that have been enumerated is by arranging them into those which belong to either of the two hearts, those of the right heart belonging to changes in the venous, and those of the left heart to changes in the arterial, system.

But even this subdivision of the symptoms is not always practically correct, for, in many examples of the heart's diseases, we shall find that both the venous and the arterial circulations are deranged, so that symptoms are present which belong to both classes.

On this part of the work, which professes to treat of the semiology of the heart, I have dwelt more fully, being strongly impressed with the opinion that, if the account which I have given of the physiological symptoms be correct, it will very materially contribute to enable the practitioner of the healing art to discriminate with more accuracy and administer remedies with more confidence than hitherto; and thus, too, he will avoid those serious mistakes which daily experience must convince every inquiring and impartial mind are constantly made, and be aware of the imperfections and fallacies which inevitably result from relying chiefly on *physical* signs in the diagnosis of disease.

The observations which have been made on the physiological symptoms, I may likewise remark, have been the result of long experience and multiplied observation; and, having also made them the subject of conversation with those in whom I could rely for their judgment and their unprejudiced minds, I have thus been with the more confidence emboldened to present them to the indulgent reader.

To the quotations which have been occasionally made from the works of history and fiction I may also allude, for it is remarkable that these should convey a more lucid explanation of some of the phenomena of the economy than are to be found in the works of any of the most distinguished physiological writers.

And it may be remarked that these inquiries into the physiological symptoms of the diseases of the heart have been conducted without having had recourse to *experiments* on animals. I have long been convinced that a knowledge of the healthy structure and of the healthy functions, of the diseased structures and the diseased functions, of the different organs is the sure path to follow when investigating the nature of diseases, and laying down the most appropriate principles for their treatment.

In the dark ages, when the dissection of the human body was prohibited, it is not surprising that inquiring minds should have resorted to the dissection of animals, and that, when they had become acquainted with the structure of their organs, they should have been arrested with the phenomena exhibited by inspecting them when alive.

But since human anatomy has been so fully investigated, and as a rational physiology has been revealed, founded upon the solid basis of the structure of the body, experiments on animals have but little contributed to advance physiological science. On the contrary, the discordant results, and the false theories and hypotheses that have been built upon them, have encumbered and checked the progress of sound inquiry.

" How is it that, if experiments be worthy of the confidence which some have reposed in them, the most able physiologists are continually at variance as to the facts elicited from them, — one thing being observed by one experimenter, and something quite different, even diametrically opposite, by another? Inferences drawn from an experiment on an animal are not always applicable to man; neither is an experiment on one class of beings applicable to the other classes." Majendie.

CHAPTER XIII.

THE ANATOMICAL SYMPTOMS OF THE DISEASES OF THE HEART IN GENERAL.

General observations on the anatomical symptoms; they are to be discriminated by the senses of touch and of hearing; importance of the anatomical symptoms; enumeration of the anatomical symptoms; the impulse ; *it is the measure of the force of the heart; its variations both in health and in disease; its importance in semiology; the* sounds *of the heart; the sounds caused by the blood's currents; illustrated in external and varicose aneurisms, and in the diseases of the heart's valves; causes of the currents bein changed; only two of the sounds audible; how these are produced; changes to which they are liable; little attention paid to this subject by the older pathologists; the sense of hearing requires culture; its acuteness varies in different persons; how the sounds are changed by particular diseases; the names by which the different sounds are designated; mode of examining the sounds by the naked ear and the stethoscope; symptoms afforded by* percussion ; *by the* sensibility *to the touch; by peculiarities in the* form *of the chest; by different* positions *of the body.*

THE class of symptoms which I have hitherto endeavoured to investigate entirely arise from, or are the effects of, that influence which disturbances of the circulation create on those organs with which the functions of the heart are most intimately associated; and we now come to the consideration of those which have been denominated the local or *anatomical* symptoms,—that class which is recognisable by the senses of an observer; the physiological symptoms being perceptible only to the patient himself. See p. 143.

In the diseases of the internal viscera, as those of the liver, the anatomical symptoms are pointed out by observing, through the integuments, such alterations in the form of that viscus as can be perceived by the senses of touch and of sight; and, likewise, by testing different degrees of its sensibility. And, also, in affections of the brain, besides the physiological symptoms, there are morbid sensations in the head felt by the patient, such as headache, giddiness, and tenderness to the touch.

But, in the disorders of the heart, in addition to visible changes in the form of the parietes of the chest, in the sensibility of the parts to the touch, and in the nature of its contents, whether they are solid, fluid, or aeriform, there are local symptoms to be observed, one order of which is derived from changes in the blow given to the walls of the chest by the heart itself; and another from changes in those sounds caused by alterations in the currents of the blood as they pass through its different cavities.

As every alteration in the structure and functions of the heart is accompanied with a corresponding change in its *impulse, sounds, rhythm, form,* and in its *sensibility* to the touch; and, as all these changes constitute an essential class of *symptoms* in the heart's disorders, each merits a separate consideration.

Symptoms derived from Changes in the Impulse of the Heart.

Viewing the heart simply as a physical apparatus, it must not be compared, as it often has been, to a common syringe, intended merely for the purpose of propelling the blood into the arterial system. It ought to be considered as an engine composed of separate compartments, each of which is endowed with contractile powers for evacuating their fluid contents, the right heart propelling the venous blood into the lungs, and the left heart, the arterial blood throughout the system, so that the changes produced in the form of the heart by its alternate contractions and dilatations cause considerable movements in its soft parietes, and which movements are communicated to the contiguous solid walls of the chest. See p. 9.

The impulse is a measure of the heart's force.

By placing the hand upon the præcordial region we are able to feel the movements of the heart; and, as I have already observed, the shock or *impulse* which is caused by its tilting may be taken as a measure of the increase and diminution of the force of the contractions of the heart.

The differences in the impulse of the heart are very considerable in its healthy condition, these differences arising either from peculiarities in the natural form, or in the thickness of the walls of the chest—from differences in the bulk of the heart, and also from differences in the natural vigour of the constitution; and hence, in common language, we talk of a heart "bounding with joy," and of a heart "subdued by sorrow."

"The *force* of the heart," observes Senac, "is constantly varying. The vicissitudes of age, the impressions of surrounding bodies, food, or abstinence, all influence its movements;" and the frequency of the beatings of the heart is usually increased with the impulse.

In order, therefore, to be able to form a just estimate of the variations in the impulse of the heart, caused by diseases, we must first become acquainted with its variations in healthy persons.

We shall be in a particular manner struck with a great *increase* in the impulse when the heart becomes gorged with blood, as takes place after any violent exercise, and with a *diminution* in the impulse, or even with its becoming imperceptible, in those who are suffering from debility or temporary exhaustion, as we see exemplified in syncope.

Having by the exercise of the sense of touch become familiar with all those temporary alterations to which the impulse of the heart is constantly liable, we are then prepared to examine its changes in disease.

Changes in the impulse;

The impulse varies in every possible degree in the different morbid conditions of the heart. Sometimes it gives a shock to the chest so severe as to cause it not only to be felt by the patient himself, but even to be visible to those present. An increased impulse of the heart indicates two very different conditions of the circulation in the arterial and capillary systems.

its increase;

If there be an increased impulse without any organic change in the heart, the whole vascular system participates, as may be observed in all febrile diseases.

But if there be an increased impulse from an impedimen to the exit of the blood from the heart, causing the heart to act more vigorously to overcome the obstacle, then, in place of an increased vascular action, the vigour of the circulation in the arterial and capillary system is diminished; and in such cases the cardiac and arterial pulses do not correspond.

"My heart beats thicker than a fever'd pulse."—SHAKSPEAR.

Its diminution.

In some affections of the heart the impulse becomes extremely feeble, and sometimes quite imperceptible; and such languor of the circulation may arise either from general debility, or it may be caused by some obstruction to the circulation, producing an accumulation of blood within the heart's cavities which they have not the power to expel.

Palpitation.

When the intensity of the impulse is so much increased that the beatings of the heart are perceived by the patient, it has then been considered a distinct disease, and called *palpitation*. It is, however, evident that the term designates only a symptom, for palpitation accompanies many of the diseases of the heart.

"The motion thus named is a contraction or dilatation of the heart that is performed with more *rapidity*, and generally also with more *force*, than usual; and when, at the same time, the heart strikes with more than usual violence against the inside of the ribs, producing often a considerable *sound*."

Cullen.

The impulse differs during expiration and inspiration.

When examining the heart's impulse it will be of consequence to notice its differences during expiration and inspiration; for it is clear that during inspiration, when the air-cells of the lungs are fully distended, the beatings of the heart will be less forcible than during expiration, when the lungs are comparatively in a state of collapse; and, consequently, the blow given by the heart to the parietes of the chest will then be much stronger. For the same reason the second stroke of the heart is louder than the first; the third is weaker than the first; and the fourth still weaker than the third—a fact which can easily be ascertained by personal examination.

So, likewise, must the impulse of the heart be modified in the various attitudes of the body.

and in the different attitudes of the body

When a person has been for some time in the recumbent posture, and the breathing is calm and undisturbed, the heart's pulse will be observed to beat precisely four times during each act of aspiration, two of the pulsations taking place during inspiration, and the other two during expiration; and there is a difference distinctly perceptible in each of the four pulses of the heart. The two beats which take place during inspiration are stronger than those during expiration.

Symptoms derived from Changes in the Sounds of the Heart.

Essential as a familiar acquaintance with the impulse may be when investigating the varied morbid conditions of the heart, of equal importance is a knowledge of the changes in its *sounds*.

The sounds are caused by the currents of the blood.

Now, as it is evident that the two sounds so distinctly perceptible to a common ear, placed upon the præcordial region, are caused by the *currents* of the blood flowing through the cavities of the heart, every change in the form of these cavities, either from an alteration in the structure of their walls or in the valves of their communicating orifices, must alter the currents of the blood, and produce corresponding changes in the sounds.

The true aneurisms illustrate this;

External *aneurisms* afford most favourable opportunities of observing sounds produced by alterations in the currents of the blood; the *whizzing* noise so characteristic of the aneurismal swelling being caused by the stream of blood passing out of the natural channel of the artery through the mouth of the aneurismal sac, and repassing from the aneurismal sac into the artery.

also the varicose aneurism,

Still more characteristic is the sound produced in the *varicose* aneurism by the current of blood which passes through the artificial orifice that has been made in the artery, and also by that current which passes through the corresponding opening into the vein. The sound which is produced by these two currents was described by William

Hunter, "as if there was a blast of air passing through a small hole, like what is produced in the mouth by continuing the sound of the letter H in a whisper."

[illegible]

A favourable opportunity of observing the effects of changes in the currents of the blood in altering the sounds of the heart is offered in those cases wherein the valvular apparatus is diseased; and such serious effects are sometimes produced in the blood's currents as to cause not only changes in the natural sounds, but even to cause entirely new sounds.

[illegible]

But changes in the velocity and in the direction of the blood's currents, it should be borne in mind, must be constantly taking place in the healthy condition of the body. The fact that the velocity in the efflux of the systemic blood, and in the influx of the pulmonic blood, is always changing, and also the circumstance of the great inequality in the surface of the heart's different cavities, which execute the important offices not only of giving special directions to the currents, but also of mixing the bloods, must each contribute to render the changes in the blood's currents almost endless; and, although it must be admitted that all such modifications will cause corresponding changes in the sounds, yet it cannot be supposed that these changes can each be recognisable by our sense of hearing.

When, however, changes in the currents of the blood do take place to a certain degree, the corresponding sounds may be sufficiently intense to become audible to a competent observer.

Subject to constant alterations as the currents of the blood must, indisputably, be in the different cavities of the heart, in a healthy condition of the circulating organs, what an endless variety will they not present when, from disease, interruptions more or less considerable are caused either to the influx or to the efflux of the blood, or from the different cavities of the heart into one another! Indeed the sounds in the heart must, doubtless, [illegible] the ear be not able to discriminate them, undergo [illegible] as numerous, at least, as the beats of the arterial pulse—the pulse being nothing more than an indication of alterations which take place in the current of the systemic blood as it leaves the heart.

Causes of changes in the blood's currents.

To elucidate still further these observations it will be well to state more in detail those changes in the central organ of the circulation which must modify the currents of the blood sufficiently to produce a sensible alteration in the sounds of the heart.

Muscular exertions.

The increased rapidity of the circulation which arises from a severe muscular exertion, the effects of the full inspirations which accompany surprise, fear, and other mental emotions, and the influence of the digestive process upon the action of the heart, must, it connot be denied, all produce changes, or, at least, temporarily modify the currents of the blood—changes, indeed, which are all recognised by corresponding changes in the arterial pulse. No less remarkable must be the effects of an irritable state of the interior surface of the heart, or of the *endocardium*, in changing the currents of the blood. Like an irritable urinary bladder, which is excited to contract by every spoonful of urine collected in it, so the parietes of the heart's cavities will, under similar circumstances, contract so frequently that the currents of the blood must be greatly altered.

Inflammatory affections:

A similar effect will be produced by an inflamed state of any of the other structures of the heart, all these being more or less exposed either directly to the stimulus of the vital fluid, or to the influence of the movements of the heart itself.

from a diminution of blood;

And, likewise, essential differences in the currents will arise when there is a diminution in the quantity of the general mass of blood, such as, after a profuse hemorrhage, when, the heart being compelled to act with unusual vigour, the blood is not ejected so quickly as the system then requires.

from structural change

Considerable as the changes must be in the blood's currents within the heart from these different causes, still more remarkable are those changes which take place when there is any structural or permanent alteration in the form of

stream of blood which is propelled by the auricular contractions through the auriculo-ventricular apertures.

These being the two great and principal currents of the blood, we may legitimately conclude that the sounds caused by them must be the most audible, and that all the varieties in the sounds which may be noted both in health and in disease will probably be the effect of alterations in these two currents.

Hence we shall find, when investigating the particular diseases of the heart, that the sounds will sometimes be altered in their *seat*, increased or diminished in their *intensity*, the *space* over which they are heard may be increased or diminished, they may be changed in *duration*, their *tone* may be modified, the *intervals* between them or the rhythm may be altered, or entirely *new* sounds may be produced.

The sounds neglected by the older writers.

Pathologists have long been aware that changes in the structure of the parietes of the heart are accompanied with particular sounds, as well as by remarkable changes in the heart's impulse; but no pains were taken to discriminate the sounds from one another, far less to refer each to the diseases of particular portions of the heart's structure, until Laennec applied his ingenious and inquiring mind to this subject.

It is, however, a curious circumstance that pathologists should have been satisfied with merely observing the changes in the *arterial* pulse, and seldom or never examining the corresponding changes in the cardiac pulse with the sounds of the heart, though, as I have before remarked, they could not have examined the arterial pulse for any other purpose than to receive information regarding the condition of the heart itself.

Page 203.

The ear requires tuition.

To acquire facility in discriminating the morbid sounds of the heart it behoves us, as has been remarked when speaking of the arterial pulse and of the heart's impulse, first to become familiar with the natural sounds by carefully examining them in numerous healthy persons, by which we may become enabled to perceive those changes in the sounds which are

[illegible] by disease. In fact, the different morbid as well as [illegible] sounds must all be heard before they can be understood. The ear requires the same tuition to enable it to distinguish the morbid sounds of the heart as the eye to be able to discriminate the different shades of the colours in diseased structures.

[illegible]

It is well, however, to be aware that the more minute changes in the heart's sounds cannot be perceived by all observers alike, for the acuteness of the sense of hearing varies exceedingly in different people, and it frequently happens that a sound which is distinctly audible to one person cannot be perceived by another. I am, therefore, convinced that there are many who do not possess the sense of hearing sufficiently acute to enable them, even after an attentive culture, to distinguish those nicer shades of difference in the sounds of a diseased heart which others may be able to discriminate; and from this may have arisen the numerous errors in diagnosis which are made by those who have trusted to their sense of hearing. It is told of a celebrated musician that the nicety of his ear was such that he could distinguish the hundredth part of a note in music—an acuteness which to some may appear incredible. At the same time it is well known that prisoners who have been long in solitary confinement acquire an extraordinary acuteness of hearing from the silence of their dungeon, and perhaps also from the ear not being excited, even by their own voice. Such, indeed, is the sensibility of the auditory organ, that when a person is in a situation of perfect and undisturbed tranquillity, as upon the top of a lofty mountain, and beyond the habitation of every animal, an accidental noise gives much uneasiness.

Extraordinary acuteness of hearing.

The same remark applies to the other organs of sense; and it is perfectly well known that there are individuals who possess the power of discriminating colours, tastes, odours, and tangible bodies with an extraordinary degree of nicety; though all such instances of perfection of our senses ought rather to be considered *exceptions* than as a general attri-
ute of man.

How changed by diseases.

The variations in the heart's *sounds* being once established as signs in its diseases and a means to discriminate the alterations which they undergo, some pathologists were naturally led to inquire what the changes of structure were by which each of the morbid sounds was produced. By comparing them with the corresponding alterations in the heart's structure, found after death, they have thus been able to refer particular sounds to diseases of particular parts of that organ, and to establish the varied sounds as an important branch of semiology.

By way of illustrating the information to be derived from an acquaintance with the diseased sounds of the heart, let it be supposed that a peculiar sound has been recognised, and which is known to be the effect of that alteration in the current of the blood caused by an aneurismal sac; then, whenever we meet with a patient in whom this sound exists, along with other symptoms which usually accompany that disease, we can pronounce with confidence the presence of an aneurism. The advantages in diagnosis which are derived from a knowledge of the sounds which accompany alterations in the different structures of the heart is also well exemplified in diseases of the auriculo-ventricular orifices, changes in their valves producing peculiar sounds or *murmurs* which are quite different from those sounds belonging to an aneurismal tumour. It is, indeed, easy to perceive how a very different sound should be produced by the obstructed circulation from thickened and unyielding valves to that change in the current of the blood which is caused by the calibre of an artery being enlarged at a particular part.

There are, however, some sounds to which pathologists have not yet been able to affix accurately the corresponding changes of structure; neither could it be reasonably anticipated, in many of those cases of disease where there are several portions and several different structures of the heart simultaneously affected, that in such complications much accurate information could be possibly derived from observing the varied sounds.

Names given to the sounds

To the indefatigable labours of Laennec we are indebted

Hunter, "as if there was a blast of air passing through a small hole, like what is produced in the mouth by continuing the sounds of the letter R in a whisper."

(Med. Obser. and Inq., vol. ii.)

and the diseases of the valves.

A favourable opportunity of observing the effects of changes in the currents of the blood in altering the sounds of the heart is offered in those cases wherein the *valvular* apparatus is diseased; and such serious effects are sometimes produced in the blood's currents as to cause not only changes in the natural sounds, but even to cause entirely new sounds.

Numerous changes in the blood's currents.

But changes in the velocity and in the direction of the blood's currents, it should be borne in mind, must be constantly taking place in the healthy condition of the body. The fact that the velocity in the efflux of the systemic blood, and in the influx of the pulmonic blood, is always changing, and also the circumstance of the great inequality in the surface of the heart's different cavaties, which execute the important offices not only of giving special directions to the currents, but also of mixing the bloods, must each contribute to render the changes in the blood's currents almost endless; and, although it must be admitted that all such modifications will cause corresponding changes in the sounds, yet it cannot be supposed that these changes can each be recognisable by our sense of hearing.

When, however, changes in the currents of the blood do take place to a certain degree, the corresponding sounds may be sufficiently intense to become audible to a competent observer.

Subject to constant alterations as the currents of the blood must, indisputably, be in the different cavities of the heart, in a healthy condition of the circulating organs, what an endless variety will they not present when, from disease, interruptions more or less considerable are caused either to the influx or to the efflux of the blood, or from the different cavities of the heart into one another! Indeed the sounds in the heart must, doubtless, though the ear be not able to discriminate them, undergo changes as numerous, at least, as the beats of the arterial pulse—the pulse being nothing more than an indication of alterations which take place in the current of the systemic blood as it leaves the heart.

Causes of changes in the blood's currents.

To elucidate still further these observations it will be well to state more in detail those changes in the central organ of the circulation which must modify the currents of the blood sufficiently to produce a sensible alteration in the sounds of the heart.

Muscular exertions.

The increased rapidity of the circulation which arises from a severe muscular exertion, the effects of the full inspirations which accompany surprise, fear, and other mental emotions, and the influence of the digestive process upon the action of the heart, must, it connot be denied, all produce changes, or, at least, temporarily modify the currents of the blood—changes, indeed, which are all recognised by corresponding changes in the arterial pulse. No less remarkable must be the effects of an irritable state of the interior surface of the heart, or of the *endocardium*, in changing the currents of the blood. Like an irritable urinary bladder, which is excited to contract by every spoonful of urine collected in it, so the parietes of the heart's cavities will, under similar circumstances, contract so frequently that the currents of the blood must be greatly altered.

Inflammatory affections:

A similar effect will be produced by an inflamed state of any of the other structures of the heart, all these being more or less exposed either directly to the stimulus of the vital fluid, or to the influence of the movements of the heart itself.

from a diminution of blood;

And, likewise, essential differences in the currents will arise when there is a diminution in the quantity of the general mass of blood, such as, after a profuse hemorrhage, when, the heart being compelled to act with unusual vigour, the blood is not ejected so quickly as the system then requires.

from structural change

Considerable as the changes must be in the blood's currents within the heart from these different causes, still more remarkable are those changes which take place when there is any structural or permanent alteration in the form of the heart's cavities, more especially in their valvular apparatus.

in the right heart,

Reviewing the structure of the right heart, we readily perceive how much the currents of the pulmonic blood must be altered by any structural changes which will have the effect of altering the direction or velocity in the stream of blood in either of the cavæ veins; or by any changes in the form of the right auriculo-ventricular or pulmonic valves.

and in the left heart.

So, also, the changes in the currents of the blood, and consequently in the sounds of the heart, must be equally numerous when either the auriculo-ventricular orifice of the systemic heart, or the aortic valves, become altered in structure.

Thus it will appear, from all I have now stated, that the sounds of the heart must necessarily undergo an almost infinite series of changes—changes varying in degree from such as are caused by the smallest possible variations in the currents of the blood, to those of so great an intensity produced by morbid changes in the structure of the heart as will completely alter the usual course of the vital stream, and not only alter the intensity and character of the natural sounds, but will even produce entirely new sounds.

Only two sounds are audible.

Those minute changes in the sounds, and those which are merely transitory, cannot, as I have already said, be recognised, even by the most acute ear, more than the slighter variations in the sounds of sonorous bodies, or the *minute* differences in the shades of colours by an untutored *eye.* And, therefore, it is only when the natural sounds of the heart are considerably altered that their changes can be at all recognised.

How these are produced.

I have already remarked that there are only two sounds of that infinite series produced by the various alterations in the currents of the blood within the heart which are sufficiently loud to be recognised by a common ear,—one of these being, probably, caused by the vital streams which are forced into the systemic and pulmonic arteries by the powerful ventricular contractions, and the other by the

stream of blood which is propelled by the auricular contractions through the auriculo-ventricular apertures.

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Differences in the acuteness of hearing.

It is well, however, to be aware that the more minute changes in the heart's sounds cannot be perceived by all observers alike; for the acuteness of the sense of hearing varies exceedingly in different people, and it frequently happens that a sound which is distinctly audible to one person cannot be perceived by another. I am, therefore, convinced that there are many who do not possess the sense of hearing sufficiently acute to enable them, even after an attentive culture, to distinguish those nicer shades of difference in the sounds of a diseased heart which others may be able to discriminate; and from this may have arisen the numerous errors in diagnosis which are made by those who have trusted to their sense of hearing.

Extraordinary acuteness in hearing.

It is told of a celebrated musician that the nicety of his ear was such that he could distinguish the hundredth part of a note in music—an acuteness which to some may appear incredible. At the same time it is well known that prisoners who have been long in solitary confinement acquire an extraordinary acuteness of hearing from the silence of their dungeon, and perhaps also from the ear not being excited, even by their own voice. Such, indeed, is the sensibility of the auditory organ, that when a person is in a situation of perfect and undisturbed tranquillity, as upon the top of a lofty mountain, and beyond the habitation of every animal, an accidental noise gives much uneasiness.

The same remark applies to the other organs of sense; and it is perfectly well known that there are individuals who possess the power of discriminating colours, tastes, odours, and tangible bodies with an extraordinary degree of nicety; though all such instances of perfection of our senses ought rather to be considered exceptions than as a general attribute of man.

How changed by diseases.

The variations in the heart's *sounds* being once established as signs in its diseases and a means to discriminate the alterations which they undergo, some pathologists were naturally led to inquire what the changes of structure were by which each of the morbid sounds was produced. By comparing them with the corresponding alterations in the heart's structure, found after death, they have thus been able to refer particular sounds to diseases of particular parts of that organ, and to establish the varied sounds as an important branch of semiology.

By way of illustrating the information to be derived from an acquaintance with the diseased sounds of the heart, let it be supposed that a peculiar sound has been recognised, and which is known to be the effect of that alteration in the current of the blood caused by an aneurismal sac; then, whenever we meet with a patient in whom this sound exists, along with other symptoms which usually accompany that disease, we can pronounce with confidence the presence of an aneurism. The advantages in diagnosis which are derived from a knowledge of the sounds which accompany alterations in the different structures of the heart is also well exemplified in diseases of the auriculo-ventricular orifices, changes in their valves producing peculiar sounds or *murmurs* which are quite different from those sounds belonging to an aneurismal tumour. It is, indeed, easy to perceive how a very different sound should be produced by the obstructed circulation from thickened and unyielding valves to that change in the current of the blood which is caused by the calibre of an artery being enlarged at a particular part.

There are, however, some sounds to which pathologists have not yet been able to affix accurately the corresponding changes of structure; neither could it be reasonably anticipated, in many of those cases of disease where there are several portions and several different structures of the heart simultaneously affected, that in such complications much accurate information could be possibly derived from observing the varied sounds.

Names given to the sounds

To the indefatigable labours of Laennec we are indebted for having pointed out the more important diseased sounds of the heart, affixing names to each of them; and these he chose from their resemblance to sounds with which every one is familiar—such as the noise of a pair of bellows, the action of a saw or of a file, or the purring of a cat. In adopting this method he followed the example of mineralogists, who have made a similar nomenclature with regard to colours, tastes, smells, and objects of touch, by comparing each with that quality belonging to some well-known animal or vegetable substance. And there is a figurative language used by painters and musicians, which is the only mode by which they can express the different shades and combinations of colours, and the various modulations and combinations of sounds.

It would, however, be in vain attempting to describe and distinguish by appropriate names all those nice variations in the sounds of the heart which accompany its numerous forms of disease. Such an attempt would be just as futile as it would be for a painter to give an intelligible description of the almost infinite variety in the shades of the different colours in a picture. Indeed, what I have said of the difficulty in discriminating the varieties of the arterial pulse is strictly applicable to the sounds of the heart.

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Changes in the sounds enumerated.

As the modifications in the sounds afford an important class of symptoms in diseases of the heart, it will be expedient to review them first in a general* manner, and afterwards, when treating of particular diseases, to describe those sounds which pathologists have been able to discriminate as appertaining to each disease; at the same time it must be admitted that there are many of these which we are not yet able to explain, and which we cannot refer to any particular malady.

Of the different sounds one class consists of changes in the two natural and audible sounds, such as alterations in their seat, extent, intensity, rhythm, and tone; and there are, likewise, morbid sounds or *murmurs*, as those of blowing and of friction, which accompany changes both in the functions and in the structures of the heart.

With regard to the *seat* of the sounds, it sometimes happens that the position of the heart is altered from changes in the form of the adjacent viscera, or that its bulk is altered; by either of which there is an alteration in the seat of the sounds.

Changes in their seat;

In *extent* the heart's sounds may be very circumscribed, being limited to the precordial region, or they may be recognised over more or less of the thorax. When the walls of the heart have become thinner and softer than natural, and when the muscular portion of the heart has lost its power, the sounds are extremely feeble, and sometimes become almost inaudible.

changes in their extent;

And when the heart's vigour is increased, as from a violent muscular exertion or moral excitement, there is then a corresponding increase in the extent to which the sounds are heard; and, likewise, when, from any mechanical impediment to the passage of the blood through the cavities of the heart, the sounds being proportionably increased, they are, consequently, recognised over a larger extent of the thorax.

The diminution and the increase in the *intensity* of the sounds, and the extent to which they are heard, correspond exactly, so that, whilst in some states of the heart the sounds are so feeble as not to be audible, in other examples of disease the heart contracts with such force that they can be heard over the whole chest, and are so intense as even to be perceptible to an observer. The sounds, too, become louder when the cavities of the heart are preternaturally dilated; the fluid blood being a much better conductor of sound than the solid walls of the ventricles.

in their intensity;

In *frequency* the beating of the heart is subject to all those variations indicated by the arterial pulse, and the cardiac pulsations are, in some instances, so rapid that they cannot be counted, no more than those of the arterial pulse.

in their frequency;

Such increase in the frequency of the cardiac pulse is usually the effect of causes similar to those which *increase* the pulse of the arteries, and, as has been already mentioned, such changes in the frequency of the arterial pulse are observed in febrile diseases, in inflammatory affections of the serous surfaces of the heart, and in those ailments wherein some organic change has taken place in the heart's cavities, and by which there is some mechanical impediment to the transit of the blood.

A *decrease* in the frequency of the heart's pulse is equally well marked by the arterial pulse as its increase; and I have already mentioned some remarkable examples of its slowness.

In their regularity;

In their *regularity* the sounds are often changed, and these changes accord with those which are characteristic of the *intermittent* pulse; for in the same manner as the beats of the heart, by varying in their force, are not always sufficiently strong to cause a corresponding pulsation in the radial artery, so we find that the sounds are not always perceptible.

Hence, from the same causes, we have irregularities in both the cardiac and radial pulse, and also changes in the order and in the duration of the sounds; all which are generally produced by structural changes in the apparatus of the central organ.

In their number;

In *number* the sounds of the heart also vary. In some diseases only one of the sounds has been recognised; and this may arise either from the first being so much prolonged, or so changed, as to obscure the second sound; or from the second sound being so feeble as not to be recognisable.

In some diseases, as in those where there is a contraction of the auriculo-ventricular orifices, *new* sounds are superadded, so that in some instances three or four distinct sounds have been discriminated at each beat of the heart.

([illegible].)

In their tone.

We naturally expect to find that, as the varieties of the sounds are caused by changes in the currents of the blood, their *tone* will also be variously modified, just as the tone of the sounds of the respiratory organs is altered by changes in the velocity of the currents of the air which passes through the bronchi, trachea, and larynx.

In diseases of the heart the sounds are sometimes *sharper*, or sometimes *duller*, than natural; and in estimating these differences it is necessary to be aware whether the sound be conveyed to the organ of hearing by a wooden or a metallic instrument, or by the naked ear, as the tone is different in each; for, if the sound be conducted by an instrument which doubles the velocity of the sound, the *tone* will then be one octave higher.

There is no more important point of consideration than the accordance in the cardiac and arterial pulses, in the impulse, and in the sounds of the heart.

In one class of cases, as in inflammatory diseases, we find that there is a correspondence or unity in all these four symptoms, the vigour and frequency of both the cardiac and arterial pulse being increased, as well as the intensity of the impulse and of the sounds.

In another class of cases the changes in these signs by no means correspond, as where there is a mechanical obstruction to the circulation within the heart, the impulse may then be increased, and the vigour of the arterial pulse diminished; and when there are obstructions through the aortic valves the impulse may be feeble and the sounds louder.

Sounds perceptible to the patient.

There are, likewise, sounds of the heart which, as I have already observed, are heard by the patients themselves. In a case of diseased mitral valves the man was annoyed at night, when in bed, with a sound which, being a husbandman, he supposed to be a dog barking at a neighbouring farmhouse.

See page 179.

Sounds of blowing.

The bellows sound, or that of *blowing*, is one of the most frequent, and under which term a variety of modifications of the sounds have been comprehended, such as sawing, filing, grating, whizzing, and whistling. These various sounds arise from the infinite variety of the blood's currents in its passage through the heart's cavities, in consequence of disease of the valves or of different portions of the interior membrane of the heart.

We must not, however, conclude that the sounds of blowing are only to be heard when there is an obstruction in the valvular apparatus; neither must we conclude that such an obstruction is always accompanied with such sounds. These sounds are often met with when there are no diseased changes in the parietes of the heart; but, when changes have taken place in the quantity or in the quality of the blood, as we may observe in those cases where there has been a profuse hemorrhage, in chlorosis, in jaundice, and in rheumatism; and, on the other hand, obstructions to the blood's currents, from structural changes, have been found after death, when no sounds had been detected during life.

Sounds of friction.

There are sounds which are formed external to the heart, and are caused by changes in the structure of the pericardium; and to distinguish these from those of blowing, or from those produced by changes in the blood's currents, they have been denominated the sounds of *friction*.

The office of the pericardium being not only, by its connection with the mediastinum and the diaphragm, to suspend the heart and prevent its displacement during its unceasing movements, but also to facilitate its motions upon the adjacent parts by its smooth and moistened surfaces, whenever any change takes place, such as frequently happens from the effusion of lymph or the ossification of the membrane, the friction of the two rugged surfaces against one another may create sounds.

The sounds caused by pericardial friction vary in their character, being sometimes rustling, crackling, or rasping, or emitting a sound like that produced by new leather.

Subject concluded.

In concluding these observations on the sounds of the heart, I may recapitulate that, as within the sac of a *true* aneurism there is a distinct whizzing noise, produced by the blood's stream passing from the canal of the artery into the aneurismal sac; and as we have also seen how greatly that sound is changed in the *varicose* aneurism where there are two distinct streams of blood, one passing into the aneurismal sac, and the other passing into the vein; it, therefore, appears to me legitimate to conclude that both the natural and the diseased sounds of the heart may all be referred to particular changes either in the heart's structure or functions, by which alterations are produced in the currents of the blood.

And, admitting that one of the audible sounds of the heart is produced by the current of the blood passing from the auricles into the ventricles, and the other by the stream passing from the ventricles into the great arterial trunks, these being, probably, the two largest and most rapid streams within the heart, how varied must these sounds be when only a portion of the apparatus, and how much more will they not be when several portions, of the complicated forms of the heart's cavities are changed by disease! We cannot, under such circumstances, well suppose that the multiplied currents of the blood should produce sounds each of which could be distinguished by the human ear.

The theories of the sounds.

As to the different *theories* which have been brought forward in order to explain the causes of the sounds of the heart, I must refer the curious reader to the works which have been published upon that subject, when he will find, as Majendie has observed in alluding to the discordant opinions, that "the results of physiological inquiries have not been in proportion to the number of authors who have written on the subject; on the contrary, you are disturbed by contradictions of the most glaring nature, or bewildered between a mass of theories and explanations which have no existence but in the minds of the inventors."

And, in further confirmation of this opinion, I may also quote the result of the extended and patient investigations of Barth and Roger, referring to their work for a lengthened account of the different theories that have been set forth on this subject.

Barth and Roger on Auscultation. Translated by Newbigging.

"So many works have been published on this subject that science is really encumbered by them, and through the mist of opposite theories and contradictory facts the observer is scarcely regaled by a single beam of truth."

This appears to me a fit opportunity to caution the younger branches of the medical profession against the system of endeavouring to explain the phenomena of the human economy by making experiments on *living* animals, and the opinions and sentiments which I entertain upon this subject have been so well expressed by Macilwain, in his eloquent address to the Society for Preventing Cruelty to Animals, that I am induced to quote his own words :—

"Many medical men already view vivisection, as a mode of physiological inquiry, with distrust; many are already convinced that it is useless and fallacious; I would fain believe that all view it as a plague-spot on a beautiful science which, in its most amiable and useful applications to their brother men, may be regarded as especially their own." And again he adds :—"The progress of science holds out little promise from any elaborate 'torturing of nature,' much less by that of sentient beings, since the most profound discoveries hitherto achieved have not resulted from the invention of artificial or even new facts, but from a careful study of the true relations of those which have always been matters of daily and familiar occurrence."(a)

The Use and Abuse of the Stethoscope.

The sounds to be perceived by the stethoscope,

The sounds of the heart may be discriminated either by placing the external ear on the solid walls of the chest, or by the intervention of the stethoscope, an instrument invented by Laennec, for the purpose of conveying the sounds of the heart to the ears.

or by the naked ear.

But, however well adapted the stethoscope may be to some for distinguishing the sounds, other observers prefer the ear, placed directly upon the chest. The contact of the extremity of the stethoscope is irksome to the ears of some people, and confuses the organ.

Besides, the formality of making use of such an instrument often creates alarm to the patient—a circumstance which ought on all occasions to be avoided, especially in those who are suspected to have a disease of the heart. On the other hand, the stethoscope is particularly applicable for the examination of the chests of women, and also of patients in public hospitals, and amongst those classes where due attention is not always paid to personal cleanliness.

(a) "Remarks on Vivisection, &c. &c. &c." By George Macilwain, Esq. 1847.

Imperfection of Laennec's stethoscope;

In regard to the construction of the stethoscope, I may briefly notice that an instrument made of a large wooden cylinder, with a column of air admitted through it, as recommended by Laennec, is not calculated to fulfil the purpose for which it is intended. Acoustic experiments have shown that wood is not a good conductor of sound, and a column of air is a much worse conductor than wood; so that the increased intensity of the sound and the supposed condensation of the air produced by the trumpet-shaped mouth of Laennec's instrument are fallacious. A stethoscope made of solid wood is, therefore, preferable to the hollow instrument.

how to be remedied.

But if it be desirable to *increase* the intensity of a sound, in like manner as it often is to increase the bulk of an object by viewing it through a lens, that will be accomplished by making the instrument of a material which is known to be a good conductor of sound, such as cast iron, steel, copper, or silver.

Such an instrument is surely preferable to the practice which has been recommended of employing means to increase the action of the heart itself.

"Those who are suspected to have an affection of the heart are directed to walk rapidly, or to go quickly up stairs, by which they accelerate the circulation, and thus exaggerate, if not develop, phenomena which would have escaped our notice, or would not have otherwise have existed."

Newbigging.

The iron stethoscope should consist of a solid iron stem, three-quarters of an inch in diameter, one end of which is to be rounded off and made slightly conical, so as to rest only upon the edge of the external meatus, whilst its other extremity is expanded so as to cover a surface of the chest of an inch and a half. The elastic nature of the iron enables it not only to convey a current of sound, but to increase its intensity—a physical fact familiarly known by the practice of ascertaining the boiling of water in a kettle by applying one end of a poker to the kettle and the other to the external

See Appendix N.

ear; and also by the common experiment of suspending a poker or iron rod by a cord, which is placed in contact with the ear, and when the rod is struck with a piece of metal, the slightest blow produces a sound of almost incredible intensity.

So much has been said both in favour and condemnatory of auscultation that to determine the real value of the physical means of exploring the diseases of the heart is a matter of grave importance.

It is impossible to discuss with candour this subject without displeasing, more or less, either its strenuous advocates or its opponents; and it is just as difficult to find out the unsuccessful result of auscultation as it is of the evil effects of medicines, or of the true result of surgical operations.

The most impartial mode of deciding this question is to embrace opportunities of watching the results of diagnoses made by those who do and of those who do not rely on auscultation. It would be unjust to take our own experience alone, for there cannot be a doubt but that every person has not the same power of discriminating the sounds of the heart in all their different phases. By practice the sense of hearing may, no doubt, be greatly improved; but I am well persuaded that, as the eye in many persons can by no tuition be improved in its power of discriminating the nicer varieties in form and in colour, so it is with the ear; as there are many who cannot distinguish the slighter differences in the intensity of sounds, and who are quite incapable of perceiving the differences of tones, from the want of a musical ear.

From the numerous observations which I have been enabled to make on the opinions and practice of others, I must confess that I have known very many instances of serious mistakes to have arisen from *confiding* in a stethoscopic examination; and, having been engaged in the practice of the profession long before auscultation was employed, I am bound to say that whatever advantages may be derived from auscultation, when judiciously resorted to, and when combined along with an inquiry into all the assemblages of the general symptoms, yet I must confess that, in consequence of most of those who profess to have acquired dexterity in using it from neglecting to investigate the physiological symptoms, more errors in diagnosis have come within my own knowledge than in former times were committed by those whose attention was solely directed both to the local and to the general symptoms.

I have also had many opportunities of testing the accuracy, by the lapse of time, of stethoscopic investigations; and I am ready to admit that I have become acquainted with many, I may truly say very many, serious mistakes. Above all, I have heard so perfectly opposite opinions given in cases of organic changes of the heart, by those who were well accustomed to the use of the stethoscope, that I have come to the conclusion that its practical utility is very limited; that the information derived from it ought to be received with much caution; and, above all, that such information, in place of superseding, should be *superadded* to that which is to be acquired by a careful examination of the physiological symptoms and the history of the disease.

The objections to stethoscopic investigations, I ought to notice, may all be removed by considering the time and the circumstances under which they are made; and, to avoid any erroneous impressions which may arise from them, it is judicious in every case first carefully to examine all the physiological symptoms, and also to acquire a minute account of the origin and progress of the disease. Whatever auscultation may afterwards reveal may be duly appreciated; and, if we are previously satisfied with the accuracy of the diagnosis and of the principles of treatment that ought to be adopted, no stethoscopic information that can be afterwards obtained, if it be not useful in confirming that opinion, can be prejudicial in the treatment of the case.

Notwithstanding all that may be said against auscultation, we ought not, therefore, to deny the utility of the information to be derived from it. 'Tis true that it may be of little practical advantage to know, in the advanced stage of disease, whether the valves of the auriculo-ventricular or the aortic orifice, or both, be changed, or whether the pericardium or endocardium, or both these membranes, be involved in a case of rheumatic or of arthritic inflammation of the heart. It may be said that there is no more advantage to be derived from such information than would be obtained for the treatment of an inflammation of the internal ear, from being able to detect whether that inflammation existed in the vestibule, in the semicircular canals, or in the cochlea; but it is of vast consequence to ascertain the changes in the sounds and in the impulse of the heart, by which, along with the general symptoms, we can, with much certainty, discriminate functional from organic diseases.

The observations which I have now made on the stethoscopic signs of diseases of the heart are amply confirmed by those of many distinguished authors, some of whom have given most decided opinions, and others incontrovertible evidence, of difficulties which they have experienced from the ambiguous language they have employed when treating on the subject of diagnosis.

In the "Dictionary of Practical Medicine," the learned author, when alluding to this subject, has observed that "no partial or empirical views should be entertained; and far less should a charlatan-parade of examination be pursued, to the neglect of *physiological* inquiry. There is as much empiricism at the present day in the modes of investigating diseases as in those of curing them; with this difference, that the empiricism of the former kind is much more *ad captandum* than the latter, and generally more fussy, and often more offensive."

I may likewise add the testimony of one highly qualified to appreciate the merits and expose the fallacies of auscultation, and who was one of its earliest advocates.

"Though a warm advocate for auscultation, I am aware that, besides the injurious and absurd affectation of pretending to understand it by some who are really particularly ignorant of it, there are others who place too much reliance on it for diagnosis, without considering the collateral constitutional symptoms."

Billing's First Principles of Medicine.

Symptoms derived from the Percussion of the Chest.

The utility of percussion.

Though *percussion,* as a means of diagnosis in diseases of the chest, had not been methodically resorted to until Avenbrugger published a work upon the subject, and till its utility was brought into general notice in France by Corvisart, and in this country by a translation and commentaries by Forbes,(a) it had, nevertheless, been frequently employed, and often, too, for the investigation of the diseases of other organs besides those of the chest, and had always been considered a useful auxiliary to determine the nature of the contents of tumours, whether solid or fluid.

"Amongst the means calculated to point out the diseases of the central organ of the circulation we ought to give a distinguished place to the *percussion* of the chest. This method, of which I have made a successful application in a great number of cases, has afforded me great assistance in practice whenever I was desirous of being assured of the sound or of the diseased state of the organs of circulation. Such, indeed, is the degree of its precision that often I have been able to determine with accuracy, which was afterwards proved by the inspection of the body after death."

Corvisart.

In the region of the heart the sound elicited by percussion is a dead sound, such as that produced on a fleshy limb; and all the other portions of the chest, being filled with air, give a hollow sound.

"The sound elicited by percussion from the healthy chest resembles the stifled sound of a drum covered with a thick woollen cloth."

Avenbrugger.

As was observed, when speaking of the necessity of tutoring the organ of hearing to enable us to distinguish the more minute sounds, the same tuition is necessary in order readily to perceive the different sounds which are elicited by percussion.

(a) "On the Use of the Stethoscope and Percussion." By John Forbes, Esq., M.D. London, 1824.

Corvisart.

"Practice alone teaches us to know the degree of resonance which a chest denotes in which the organs contained in it have not been changed, as it is the solidity of a body which causes the chest not to resound. But, in forming an opinion of the degree of the resonance, one ought to be careful to consider the natural thickness of the integuments, and the frequency of their infiltration, as these may prevent the resonance when there is no other cause for it."

Wills.

In percussing the chest it is usual to place one hand firmly on the chest, and by tapping the back of it with the points of the fingers of the other hand, the sound is readily elicited; or, in place of the hand, a solid substance may be employed; and a piece of india-rubber, about an inch square and a quarter of an inch in thickness, forms one of the best plessimeters.

The advantage derived from giving a blow upon a large and non-conducting substance is, that such a substance retains for a more lengthened period than a solid or very dense substance, such as ivory, would do, the impulse given by the blow.

Increased sensibility.

Symptoms elicited by Touch.

An *increase of sensibility* is an indication of a disorder of the heart which ought not to be disregarded. I have frequently found persons who were suffering from all the *symptoms of congestion* in the heart complain, more or less, of a *tenderness* on pressure upon the cardiac region; and the feeling of uneasiness or pain, thus created, is accompanied with a sob and difficulty in breathing.

Heartache.

Heartache, like heart-sickness, is a common but a perfectly correct expression; and those who have had the heart much excited from affliction often have a fixed pain, well as an increased uneasiness from pressure, in the diac region.

In inflammatory affections of the chest, the degree of the inflammation is usually tested by the pain produced by a full inspiration, or by the effect of coughing, the pain in such cases being caused by moving and altering the position of the diseased parts. But if the inspirations are very limited, as in pulmo-cardiac congestion, and the patient be unable to distend the chest, yet the effort does not create local pain, and there is merely an inability to expand the lungs fully, from the inordinate congestion of the pulmonary vessels.

Symptoms derived from Differences in the Form of the Chest.

The form of the chest likewise deserves attention in the diagnosis of affections of the heart. It is a general remark that those who have tuberculated lungs, or who are predisposed to pulmonary affections, have the capacity of the thorax small. Now, I have almost invariably observed that it is quite the reverse in those who have a disordered heart. If I could venture to lay down any general rule on this point, I should say that in those who are affected, or who are predisposed to diseases of the heart, the chest in general is full and well developed; and which formation may serve as a diagnostic mark of the disorders of this organ, and primary affections of the lungs—more especially in pulmonary consumption.

Symptoms derived from Changes of Posture.

" All the positions which patients attacked with organic affections of the heart can take in bed are not equally favourable to respiration. It is indifferent to him whether he lie on the left or the right side; most usually he can respire with least difficulty whilst sitting; he inclines the body backwards, and bends the trunk so as to throw the anterior part of the chest forward. It is in consequence of this forced attitude that he experiences a relief to enable him to sleep. This position, however, is not the only one which is favourable to respiration; and often the individual affected with the same kind of disease takes a position almost the inverse, which is no less favourable to him; he rests inclined forwards, the abdomen in contact with the thighs, and the chest close to the knees. I have seen patients preserve this position for many successive days, because it is one which renders their condition supportable."

Corvisart.

CHAPTER XIV.

THE DIAGNOSIS OF THE DISEASES OF THE HEART.

General observations; the physiological symptoms are common to the diseases of different organs; the anatomical symptoms appertain to the diseases of the heart; importance of a knowledge of the history of diseases; and of their first symptoms; and in the different classes of society; the effect of medicines to be discriminated from symptoms; diagnostic symptoms derived from the diseases of the cerebro-spinal system; *diagnostic symptoms derived from the diseases of the* respiratory system; *symptoms common to these and the heart; both systems frequently implicated; these combinations enumerated; diagnostic symptoms derived from the diseases of* digestive system; *the symptoms diagnostic of the diseases of the heart; diagnostic symptoms derived from the diseases of the* vascular system; *diagnosis of aneurism at the root of the aorta and its large vessels; diagnosis of the* venous system; *anatomical symptoms.*

The importance of diagnosis.

THE diagnosis of diseases may be considered as the stepping-stone to their treatment. The common remark, that "if a disease be accurately discriminated, it may be considered as half cured," is perfectly correct. If the whole assemblage of symptoms has been strictly analysed, the conditions of the different systems of the economy distinctly made out, the symptoms which belong to the primary disease discriminated from those of other systems which are affected, the history of the case ascertained, then, and not until then, may the remedial means be selected, and with confidence administered.

The diseases of the heart to be distinguished from those of other organs;

Although I have enumerated and endeavoured to explain various *symptoms*, both local and general, which accompany disorders of the heart, it must not, however, be concluded that all these symptoms appertain to the heart's diseases alone, or that all of them belong to any one of these diseases; for we shall find, by an examination of the general or physiological symptoms, that many of these are common to diseases of other organs as well as to those of the heart; and it cannot be supposed, that, in the extensive catalogue of the local symptoms, all of them are

and from one another.

manifested in each of the maladies of the heart. It becomes, therefore, necessary, in treating of the diagnosis of these diseases, not only to discriminate them from those of other organs, but also to distinguish them from one another. Hence the difficulties as well as the importance of their diagnosis.

In considering this subject, let us first inquire into those symptoms by which the diseases of the heart may be distinguished from those of other organs and systems of the economy; and afterwards investigate those symptoms by which its particular diseases may be distinguished from one another.

To be able to discriminate the diseases of the heart from those of other organs, it is requisite that we should not only possess a comprehensive knowledge of their local and general symptoms, but that we should also be well acquainted with the symptoms of the diseases of the other systems of the economy; for, as I have said, when treating of the physiological symptoms, that as these symptoms are derived from the different systems, in consequence of some change in the supply of their blood, so it will happen that, in their idiopathic affections, the functions of the heart will be more or less influenced. Consequently, the physiological symptoms derived from these different systems will likewise be met with independently of any disease of the heart. See page 117.

As we may readily conceive, if one portion of the structure of the heart be changed, the functions of that part alone will not be affected, but the functions of all the others will be more or less deranged, and consequently arise the numerous complications of the diseases of the heart, and the difficulties, and indeed, sometimes, the impossibility of accurately distinguishing them from one another, especially in their advanced stages, and when morbid alterations have taken place in several portions of its structures.

In order to form a correct diagnosis of the diseases of the heart, it is therefore prudent never to presume to give an opinion in any case from examining the heart alone, or from the symptoms which may be indicated by the disturbance of any particular organ or system of organs; but in every instance to investigate in succession all the systems of the economy, as well as the local or anatomical symptoms, and to view the assemblage of symptoms as one whole.

There is nothing more essential, to enable us to form a correct diagnosis, than the *history* of the disease; for, when acquainted with the first symptoms, tracing their progress, and the gradual implication of other organs, we can, in most instances, discover the organ that has been primarily affected.

A knowledge of the history of diseases essential;

Next in importance to discriminating the diseases of the heart from those of other organs, is being able to distinguish the particular diseases from one another; and this can only be successfully accomplished by a familiar acquaintance with the phenomena and causes of each disease.

But the advantages which may be derived from detecting disease in its earliest stage, and at this period to be enabled to employ the proper curative means, is a matter of primary importance in the practice of the healing art. The most serious diseases usually commence with no very alarming symptoms, and they are attended with little suffering; but these early symptoms may be quite as characteristic as those which are manifested after the disease is far advanced.

and to detect the first symptoms of disease;

Next to the advantages of distinguishing diseases at an early period of their progress, is that of being able to discriminate the peculiarities of each case; for it is with the heart, as with all other organs, that we seldom meet with two examples of the same disease which are, in every respect, similar.

and to discriminate the peculiarities of each case.

"Indeed, every physician sees some difficulties in almost every case that comes under his care; and the superiority of one practitioner over another consists in his power of discriminating, with more or less accuracy, the peculiarities of each case, and of adapting his remedies to each individual."

Barlow, Ed. Med. and Ch. Journal.

It is also essential, when investigating the diseases of the heart, and in comparing the writings of different authors on the subject, carefully to consider the class, habits, and pursuits of those persons on whom the observations are made. For there is often a very great difference in the general character of the same disease in different persons, as well as in the different classes of the community.

The differences of the heart's diseases in different classes of people.

If one class of our fellow-beings are deprived, not only of the luxuries, but even of the comforts of life, they are bereft of many of the ailments to which the wealthy and luxurious are incident, and likewise to those whose position exposes them to great mental excitements. In hospitals, and amongst the poorer class of society, diseases of the heart seldom come within observation until they have arrived at an advanced stage; and there are some diseases which we can seldom expect to meet with in those institutions.

Minute diagnosis, how to be appreciated.

However little may be the practical benefit which has hitherto resulted from attempting a minute diagnosis of the morbid changes of the particular portions of the heart's structure, nevertheless the advancement of knowledge is always to be applauded; and many facts which now appear isolated and unimportant, yet, at some future period, may be linked together and materially advance the progress of the healing art. "The history of every science shows, that, generally speaking, every addition of knowledge has been an increase of power; and innumerable discoveries could be mentioned which, at the time they were made, seemed of no value, but which eventually proved of the greatest importance. On this principle alone, were there no other reason, I should mention the utility and the importance of a minute diagnosis."

Forbes.

There is no better evidence of there being a primary disease existing in the heart, than the *absence* of all symptoms of disease in the digestive, respiratory, and nervous systems. When, therefore, we find in any case that the functions of the heart are disturbed, and that there is no derangement in either of these other organs, the existence of some organic affection of the heart may be suspected.

The diagnosis in doubtful cases.

Whenever there is any doubt as to the existence of organic disease, it is prudent always to act as if the case was one purely functional; for, besides the influence that a sanguine opinion might have on the mind of the sufferer, it gives more confidence in adopting any system of treatment calculated to relieve the symptoms. Again, it will be generally found, that whenever organic changes do exist, they present some marked symptoms, which can seldom leave a doubt of their real nature.

Effects of medicines to be considered.

As there are so many medicinal substances which influence the action of the heart, care should always be taken, in examining its diseases, to become acquainted with the treatment under which the sufferer may be at the time when an examination is made.

"The appearance or aspect of a disorder often varies according to the different methods of cure, some symptoms being rather occasioned by the physician than by the disorder itself: so that persons labouring under the same illness being differently treated have different symptoms. And hence, unless great caution be used in this point, our notions of the symptoms of diseases must necessarily be very loose and uncertain." Sydenham.

Arrangement of the subject.

In considering the *diagnosis* of diseases of the heart, I will pursue the same order as has already been adopted when treating of the different symptoms, reviewing in succession each of those systems of the œconomy which are influenced by the functions of the heart, and from which the different symptoms are derived.

The cerebro-spinal system.—We have seen how much the cerebro-spinal system is influenced by disturbances in the functions of the heart, and also that a numerous class of symptoms in the heart's diseases are derived from the consent between these two organs. But we also find that similar symptoms may arise from diseases of other organs, as well as from those of the heart. See page 155.

Diseases of the digestive organs cause similar symptoms.

With the organs of *digestion* this frequently happens, many morbid sensations in the brain and spinal chord arising from disorders of the alimentary canal, and which appear to be so much alike in their characters to those caused by a disturbed heart, that their diagnosis is of great practical value.

Morbid sensations in the head.

When alluding to certain morbid sensations in the head caused by a disturbance in the heart, I mentioned that these feelings might be produced either by a diminution or by an increase in the proportions of the arterial and venous blood within the head; but, in estimating these sensations in the head as diagnostic symptoms of a disordered heart, they must be carefully distinguished from those sensations which are caused either by some primary affection of the encephalon, or, what is far more frequent, from a derangement in the digestive organs.

Watchfulness, mental irritability, &c. &c.

Watchfulness, mental irritability and aberration, coma, and dreaming, all of which depend upon the condition of the cerebral circulation, and accompany disorders of the heart, may also arise either from morbid changes in the brain, or be symptomatic of diseases of the digestive organs. So, also, the dizziness, the swimming in the head, the difficulty in balancing the body, the ringing in the ears, and the occular spectra, all which I have pointed out as symptomatic of some affection of the heart, have been often confounded with similar symptoms arising from diseases either of the digestive organs or of the brain itself; but they can only be distinguished by a strict examination of the condition of the different organs in each particular case.

Mental depression.

The peculiar state of mind which accompanies many of the disorders of the heart will be found an useful diagnostic symptom; and nothing appears to be more characteristic of the heart being disordered, than persons who are, on other occasions, known not to be wanting in courage, expressing great apprehension of death. This state is very different from the condition of those sufferers who are afflicted with dyspepsia, and who are weary of their existence; and also from that of the furious maniac whose brain is diseased, and who is eager either to injure others, or to destroy himself.

Headache.

There is no symptom the diagnosis of which is of more practical importance than *headache*.

See page 156.

Headache, as well as other morbid sensations in the head, arising from a disordered heart, may be caused either from an increase or from a diminution in the proportion of the arterial blood within the head.

Different kinds of.

Unlike the uneasy feelings in the head, symptomatic of a disordered stomach, the headache arising from a disordered heart is of two very distinct kinds: one of them arising from an increase, and the other from a diminution, in the proportion of the arterial blood within the head; and these affections I have already fully explained.

From differences in the proportions of the blood;

Headache arising from an increase of arterial blood in the head is generally more or less permanent, varying in degree at different periods, but never ceasing altogether whilst the heart continues to be disturbed. Such headaches, I have already observed, are often accompanied with an irritable state of mind, and, in some instances, with even a temporary aberration of the intellectual powers.

The sensations in the head which are caused by a *diminution* in the proportion of the arterial blood in the brain may be readily distinguished from *plethora*, by examining the cardiac and radial pulses, as well as other concomitant symptoms. In the one, the heart's impulse may be strong, but the radial pulse will be small; whilst, in the other case, both the cardiac and the radial pulse are vigorous.

and from digestive derangements;

Those headaches which are symptomatic of digestive derangement, unlike the former, affect the sufferer at more or less distinct intervals; are, at their commencement very slight; are circumscribed and limited to a portion of the head; advance gradually in severity and often terminate in sickness and vomiting. They are preceded by irregularities in the functions of the stomach and biliary organs, and by constipation; and these symptoms are all aggravated by bloodletting, but are more or less relieved by alvine evacuations.

and from diseases of the encephalon.

The various uneasy feelings in the head, which are connected with the diseases of the encephalon and its adjacent structures, must also be carefully, and can generally be easily, discriminated from those which are caused by a disordered heart.

Dr. Baillie's case.

Nothing can be more characteristic of the pathological condition of the brain in these affections than the increase, in place of the diminution, of these sensations in the head when local bloodletting is employed for their treatment; so that bloodletting may be resorted to with discretion, even in doubtful cases, as a means of diagnosis. For it will sometimes happen, that a person who has been long subject to headache, symptomatic of digestive derangement, will suffer from a pain in the head caused by plethora; the pain of the two headaches being of different characters. The utility of bloodletting under such circumstances was well exemplified in the case of the late Dr. Baillie. He had been occasionally subject to "bilious" headaches, and on one occasion he consulted me about some uneasy sensations in the head, which appeared to be of a different description, and led me to advise him to apply a few leeches to the frontal vessels. To this he at first objected, observing that he had on several former occasions employed bloodletting to relieve the headache, but that the effect had always been rather to increase than to diminish the headache. After some explanation as to what appeared to be the difference in the cause of his present suffering, he was induced to apply the leeches; and by the bleeding he was completely relieved.

Difference in the effects of medicines.

In primary affections of the brain, accompanied by a disturbed circulation, it may be worthy of remark, that cardiac medicines are found to be useless; whilst, in primary affections of the heart, these remedies are equally efficacious in subduing such symptoms.

Importance of the history of the case.

But there is nothing which unfolds the distinction between idiopathic affections of the brain and those which are symptomatic of a disordered heart, more correctly than the *history* of the disease; and to that a constant reference should be made in forming a diagnosis in the diseases of the two organs.

Diagnosis of fits.

In those who are afflicted with *fits*, some disorder of the heart should always be suspected; but, at the same time, they may be also observed symptomatic of a disturbance of the digestive organs, or of a primary disease of the encephalon. In many cases of hysteria, epilepsy, and apoplexy, the primary seat of the disease has been found in the heart; and, indeed, I have a strong impression, that by far the greater number of those headaches which are usually called nervous are either symptomatic of some malady in the heart or of the digestive organs.

See page [illegible].

That some of these affections of the brain should be intimately connected with the state of the heart is illustrated by the striking fact of their paroxysms occurring only when the circulation is disturbed; for in this there is a striking contrast to the periodical character of many other diseases.

Convulsions, symptomatic of.

When speaking of convulsions, I pointed out that the involuntary actions of the muscles which accompanied the different kinds of fits were employed by the economy for the purpose of restoring the balance of the circulation, when that has been deranged, the muscles during their contractions increasing the blood within the heart by impeding its flow through the compressed arteries. But whilst such convulsions are efforts of the *vis conservatrix*, it is of importance to be aware that convulsions also arise from other causes, and may be symptomatic of primary disease or injury of the cerebro-spinal system; so that these two kinds of convulsions should be accurately discriminated, and each referred to that particular condition of which it is merely symptomatic.

Syncope, caused by organic disease of the heart, ought also to be carefully discriminated from that fainting state which is connected with diseases or injuries of the brain, and from that which is caused by a deranged stomach. Syncope, different causes of.

When investigating the symptoms of diseases of the heart which are derived from the cerebro-spinal system, it appeared that many of the changes in the functions of the spinal cord, as well as of the brain, were caused by changes in the functions of the heart, and that either the *sensory*, the *motor*, or both the columns of the chord, were affected by derangements of the circulation. At the same time, whilst investigating the diseases of the spinal chord, it must be kept in mind, that the functions of the spinal nerves are affected, not only in the diseases of those structures which surround the chord, but that they are also affected sympathetically. See page 153.

Examples of a sympathetic affection of the sensory nerves are very remarkable in some cases of *chorea*, where that disease arises from a derangement in the alimentary canal, in cases of *trismus* caused from an injury of the nervous system, and in other cases where the sensory column is the seat of neuralgic diseases. Hamilton on purgatives.

The Respiratory System. Next let us consider the diagnostic, signs which are afforded by the respiratory system; and from the still more intimate connexion of this system with the heart the diagnosis becomes more intricate, and demands the more close scrutiny.

The diseases of the heart are more especially complicated with those of the lungs; they are, indeed, frequently mistaken for the affections of the lungs; and the diseases of the lungs are as often mistaken for those of the heart,—an error of serious import in the practice of medicine; the more so, because the remedies which are most useful in the treatment of the one class of ailments, are either inefficacious, or may even be injurious in those of the other.

Thus, the diagnosis of the various diseases of the three vital organs,—the heart, the lungs, and the brain, opens a wide and interesting field for one of the most important inquiries in medical science.

As for the same reason that the cerebro-spinal system is not always affected in diseases of the heart, so we find that, in all its diseases, the respiratory organs do not always appear to participate. At the same time, from there being a more intimate relation between the lungs and the heart than between the heart and the nervous system, we seldom find any considerable disturbance in the heart's functions without some change in the pulmonary circulation. The two hearts are linked together through the medium of the lungs, the lungs being to the pulmonic and systemic hearts what the capillaries are to the arteries and veins, the pulmonary vessels rendering the connexion between the lungs and heart as intimate as the capillaries render that of the arterial and venous systems.

See page 71.

The instinctive acts of the economy performed by the respiratory organs conjointly with those of the circulation, and which, I have endeavoured to show, are all caused by a deranged circulation, and as they are symptoms which do not occur in primary affections of the lungs, they afford an important addition to the diagnostic symptoms of diseases of the heart.

See page 132.

We have seen, that there is no more remarkable character of a disordered heart than changes in the frequency, in the regularity, and in the intensity of the breathings.

The breathing becomes very frequent, both in diseases of the lungs and of the heart; but, when respiration is diminished below the natural standard, it is then probable that there is some disorder in the heart.

See page 260.

And the same remark applies to the regularity or proportions in the inspirations and expirations, irregularities in these indicating some derangement in the heart's functions. Hence dyspnœa and asthma are, in many instances, caused by a disordered circulation,—an important pathological fact first pointed out by Corvisart.

See page 101.

In diseases of the heart, respiration often becomes extremely languid, of which I have already quoted several examples; and it is a condition of the respiration which does not accompany disease of the lungs, but arises from a disordered heart.

That the derangement of the respiratory organs, to which I have alluded, may be considered as characteristic of a disordered heart, is further confirmed, by the manifest difference of those changes which take place in the respiration when a primary disease affects the lungs. Respiration, in pulmonary affections, is only quickened, and its rapidity is in proportion to the bulk of the portion of the lung which is incapable of receiving the air; whereas, in diseases of the heart, respiration is irregular, and more or less tumultuous, being altered by every change in the circulation of the thoracic blood.

Cough, I have already explained at some length, may be symptomatic of a disease of the heart, as well as of the lungs; and this symptom has a very different character in the different affections of the thoracic viscera; whilst the circumstance, that diseases of the heart are accompanied with cough and disturbed respiration, has, in many cases, caused such diseases to have been mistaken and treated as primary affections of the lungs. The rationale I have given of the different classes of coughs is of essential use in the diagnosis of diseases of the chest; for, although both may be combined in particular cases at different periods of the disease, still it enables us to refer each kind of cough to an affection either of the lungs or of the heart.

See page 192.

See page 193.

When the functions of the lungs have been long and seriously interrupted by a disturbance of the circulation, diseased changes of another character may supervene, and it is by no means unusual to see examples of thoracic disease, in which the heart's action has been first disturbed; and afterwards the patient has been attacked with inflammation of the mucous membrane of the bronchi, and which inflammation, superadded to the disturbed heart, creates an assemblage of symptoms, all which are apt to be attributed to a diseased state of the lungs.

In such cases the affection of the lungs becomes, sooner or later, of a more serious character, and ultimately, if the disease of the heart makes great progress, the mucous membrane of the bronchi is materially affected, and the pleura, with the parenchyma of the lungs may also suffer from the repeated attacks of bronchial inflammation.

Hemoptisis may, like cough, be accompanied by affections of the heart, as well as by diseases of the lungs; and the characters of such hæmorrhages I have already fully explained, observing, at the same time, how frequently a spitting of blood from pulmo-

See page 194.

[illegible] is mistaken for a symptom of organic disease of the lungs; and the importance of their diagnosis.

The presence of pulmonary *apoplexy* is of consequence to determine, inasmuch as it points out that a disturbance had taken place in the pulmonary circulating function. "Besides the history of the case and the foregoing symptoms, the *percussion* of the chest may point out a portion of the lung, the respiration of which is absent; the breathing will be shorter and more frequent than natural according to the extent of the pulmonary hepatization,—and there will not of necessity be present any febrile symptoms."

Though diseases of the heart have often been mistaken for affections of the lungs and diseases of the lungs for affections of the heart, there is one striking difference in those persons who are afflicted with diseases of these organs, which I have remarked to be almost universal. Those suffering from, or who have a predisposition to disease of the lungs, have the chest of small dimensions, so that the lungs are proportionately small; whereas, it will be generally found that in those who have a disorder of the heart, the cavity of the thorax is, in them, of its full dimensions: so that a large capacity of the thorax, along with the other symptoms which have been enumerated, will be found of no small importance in the diagnosis of the diseases of the thoracic viscera.

The Digestive Organs. To be acquainted with the state of the digestive apparatus, is of essential use in assisting us to form a correct diagnosis in the disorders of the heart: for as, on the one hand, so many disturbances of the circulation arise from a disorder of the digestive organs, and as the diseases originating in the heart have comparatively but little influence on them, in all cases of cardiac disease, where the digestive organs are much deranged, such a condition affords a strong presumptive proof that the affection of the heart is symptomatic of such derangement; and, on the other hand, when the action of the heart is disordered, and there is no derangement of the digestive apparatus, we may then suspect that there is some primary affection of the heart.

The relation of the stomach and the heart is of a very different character than of that between the heart and the lungs. From the functions of the lungs co-operating with the heart in the great function of the circulation, the diseases of these two organs are often necessarily combined; but as the consent between the heart and stomach depends upon the nervous system, derangements of the stomach which disturb the heart, and those of the heart which disorder the stomach, are purely sympathetic.

Such cases of disturbance of the heart are numerous; and there is nothing more common than to find its functions more or less interrupted by the presence of noxious food, or an accumulation of morbid secretions in the alimentary canal; and it therefore happens, that no class of cases have so often been mistaken for a diseased heart, as those affections which are symptomatic of a derangement of the digestive apparatus. See page 136.

The functions of the digestive organs are comparatively little influenced; and in those with diseased hearts, especially organic diseases, the organs of digestion are most commonly in a healthy condition,—an observation of importance to be kept in mind, when considering the diagnostic symptoms of organic diseases of the heart. And whilst a deranged state of the digestive organs, or some disturbance in the nervous system, may produce sympathetic affections of the heart, so the *absence* of any derangement of either of these systems, when its functions are disturbed, may be taken as a strong criterion that some local affection of the heart exists.

Vomiting and Nausea.

Vomiting, I have observed, may occur both in diseases of the heart as well as in derangements of the stomach; but the vomiting which is symptomatic of a disturbed circulation is usually preceded by nausea, or there may be nausea without vomiting.

When vomiting takes place from derangement of the stomach, that derangement is also accompanied by other symptoms, being an act resorted to by the economy solely for the purpose of evacuating from the stomach its offensive contents, or, as sometimes happens, especially in the infant, where there is a simple *regurgitation* of the surplus quantity of milk. See page 227.

Of these disorders of the stomach, causing a disturbance of the circulation, I may also mention *flatulency*, which, from the relative position of the heart and stomach, interrupts, more or less, the movements of the heart.

Case of Lænnec. "Lænnec, who died of a tubercular affection of his lungs, heard very distinctly, a few days before his death, the pulsations of his heart; and having ascertained that his stomach was distended with gas, he suspected that it was the cause, in which he was confirmed by the sounds of the heart ceasing after eructation." Newbigging.

No less remarkable are the effects of excrementitious matters collected in the alimentary canal, these not only deranging the functions of the heart, but sometimes causing such violent palpitations of the *aorta* as to lead the symptoms to be mistaken for those of aneurism; and it is of equal importance, when examining into the condition of the heart, to become acquainted with any peculiarity of food that may have been taken, or any particular medicine, as there are many of these that disturb the heart. Baillie.

See page 216. A vomiting of blood, and an intestinal *hæmorrhage*, it has been already observed, is by no means an unfrequent symptom of a disordered heart, generally appearing in affections of the right heart. And, although in the majority of cases where there is congestion of the pulmonic heart, there is also more or less congestion throughout the whole venous system; yet there is often a congestion in the abdominal veins, so that the hæmorrhoidal flux may either be symptomatic of a disordered heart, or of a disease of the chylopoietic viscera.

The Vascular System. It has been already mentioned, that, by a great nicety which may be acquired in the sense of *touch*, we can distinguish a very considerable number of modifications in the arterial pulse, and by which different conditions of the heart are more or less distinctly indicated. See page 95. I likewise observed, that however important it might be to become familiarly acquainted with the changes to which the sounds of the heart are liable, the varieties of the arterial pulse are of still greater value, inasmuch as the number of these changes are infinitely greater than those of the sounds which the ear can distinguish; that, in short, we can recognise, by means of the sense of touch, changes in the systemic circulation which cannot be detected by the audible sounds of the heart.

Changes in the heart's sounds are perceptible almost only in the more formidable affections, or in its organic diseases; whereas, by an examination of the arterial pulse, an infinite variety of disturbances in the *functions* of the heart can be readily detected.

As the changes in the functions of the arteries indicate corresponding changes in the heart's action, a knowledge of these will materially assist in forming a correct diagnosis.

An important practical inference may be drawn from the foregoing remarks; which is, that when the action of the heart is increased, and there is a corresponding increase in the pulse, the heart will probably be in a sound state; but if the action of the heart be increased, and there be no corresponding increase, but a diminution, in the vigour of the pulse, there will then probably be some change in the heart's structure.

Diagnosis of Aortic Aneurism.

The diagnosis of an *aneurism* formed at the root of the aorta must always be difficult. When small, or even of a moderate bulk, it can neither be seen, felt, nor heard; and its existence can only be suspected from its history. When it acquires a certain size, the aneurismal tumor then interferes more or less with respiration and deglutition. By its pressure upon the trachea it affects the breathing, and if it compresses the recurrent nerve the deglutition becomes more or less difficult.

It is not until the swelling has become so large as to ascend near the upper extremity of the sternum, that it can be felt, and when large enough to be distinguished, its pulsatory character can be also felt, and its whizzing noise become audible.

Aneurism can, in almost every instance, be traced to some violent exertion, to some unaccustomed muscular effort, or to some violent mental emotion; and, therefore, the *history* of the symptoms is most essential, and affords the only means of suspecting the existence of an aneurism when in its early stage. The circumstance of all the symptoms being traced back to some cause, and the circulation being much disturbed, producing giddiness or syncope, and the person suffering severely from the shock, all form additional evidence of the nature of the disease.

A varicose state of the *venous* system, as has been mentioned, is a very common symptom of a disorder of the heart; especially the veins of the head, neck, and upper extremities are affected; for when the veins of the abdominal parietes and superior extre-

See page 217.

mities are alone varicose, a disease of one of the abdominal or pelvic viscera is indicated.

The Anatomical Symptoms.—We have seen, that the physiological symptoms are common to diseases in other organs besides those of the heart; but the *anatomical* symptoms are derived solely from a derangement in the functions, or from an alteration in the structure of the heart; so that it is by a knowledge of these symptoms that we can obtain information of the particular diseases of the heart.

Whilst attention to the physiological symptoms has been greatly neglected in investigating the diseases of the heart, too much value has been placed on the anatomical, and to this must be attributed the frequent errors of diagnosis. If such be the difficulties, and if of such magnitude be the mistakes that are committed, even by the most experienced auscultators, how great must be the value of other means of diagnosis.

The physical signs have derived importance from their utility in pointing out the nature of diseases of the heart, chiefly in their advanced stages, and when medical treatment is comparatively of little avail; but in the early stages of disease these diagnostic signs are comparatively useless; for, in the treatment of every case, we ought to look to the condition of the system generally, and to the assemblage of all the symptoms; and our attention should not be distracted, when adopting a system of treatment, by attempting to distinguish any particular portion of the circulating apparatus which is deranged.

CHAPTER XV.

THE PROGNOSIS OF DISEASES OF THE HEART.

Observation of Hippocrates; danger of diseases in vital organs; many of the diseases of the heart can be remedied; erroneous opinions of their danger, and rapidity of their progress; causes of their danger; efficacy of medical treatment; injurious effect of auscultation; delicacy to be observed in giving opinions to the sick.

THE father of medicine has justly observed, "That physician who, upon the appearance of some certain signs in a disease, can tell his patient what he has hitherto suffered, and what will happen to him every day; and, after having received information from him, he not only speaks further of those things he omitted before, but also lays down beforehand what will come to pass, 't is he shall have the reputation of knowing perfectly the condition of the patient, and make him entirely resign himself to his management. And as it is not always in the power of the physician to save the lives of the sick, for that reason *prognostics* will be serviceable in some measure to secure him from reproach."

Comparative danger of the diseases of the heart.

In estimating the danger of diseases, there is no point on which greater weight should be placed than the importance of the function which the disturbed organ performs in the animal economy; and we may generally prognosticate that the same extent of disease in a vital organ is attended with more danger than a malady of equal severity in less important parts of the body.

The heart being so essential to life, any of its diseases naturally cause more or less anxiety, and, its functions being so much under the influence of the mind, the impression which a patient may happen to entertain of the result of his sufferings must materially influence the progress and termination of the disease. Neither is it to be wondered at, that those suffering from such diseases should be apt to augur unfavourably of their termination.

Many of the heart's diseases are remediable.

Essential, however, as the heart may be for the preservation of life, it is, nevertheless, subject to numerous ailments, which, although they may materially influence the comfort and happiness of those afflicted by them, are yet, as much as the diseases of any other organ, under the control of medical treatment, and many of them are not of a fatal character.

"The diseases which come from any part of the body that is considerable, are the most dangerous; for if the disease rest, that is to say lodge, in the place where it began, when a part that is of great importance suffers the whole body must suffer." Hippocrates.

It is an erroneous opinion, too frequently promulgated, that diseases of the heart are not only most dangerous, but most sudden in their attack, and rapid in their termination.

Excepting in those instances where they are caused by some great mental excitement or violent bodily exertion, the diseases of the heart usually make a very slow progress, and hence it is that, in those who die suddenly from them, it is usually found, after death, that the malady was of a character which must have been of long duration.

Their danger, how increased.

There are two circumstances, which may powerfully operate, either in diminishing or increasing the danger of the heart's diseases.

One of these arises from a common opinion, that the ailments of the heart have generally advanced too far before medical aid is afforded; and the other, when there has been a want of due care and attention during convalescence.

It is on the first appearance of the symptoms when medical treatment, judiciously employed, has such a powerful influence in subduing disease; and, if that moment be lost, changes may then quickly supervene, which, though they are mitigated, yet they may have sown the seeds of some future disease; and, however much the symptoms are afterwards controlled, they are never completely subdued.

The want of that unceasing care which is so necessary during convalescence from all diseases, is often the cause of much future mischief in those suffering from disorders of the heart; and unless the most perfect moral, as well as bodily tranquillity be preserved, until every element of disease appears to be eradicated, we may safely prognosticate that, sooner or later, there will be a relapse of all the symptoms, and the foundation laid of some permanent mischief.

Efficacy of medical treatment.

But, as I have already had occasion to observe, almost all the diseases of the heart are as much under the influence of medical treatment, especially in their early stages, as those of any other organ; and even in those cases where they have made much progress, the severe symptoms can often be greatly alleviated, and life prolonged, far beyond the most sanguine expectations.

"A wise physician will consider, whether a disease be curable, or whether or not the cure of it be not full of peril; if he find it to be such, let him resort to palliatives and alleviate the symptoms, without busying himself too much with a perfect cure; and many times, if the patient be indeed patient, that course will exceed all expectation."

Bacon, century I, p.40.[*]

Dangerous consequences of an erroneous diagnosis.

There can be no more unpardonable conduct, than to give to the patient a decided opinion of a disease being of a dangerous nature, and of confidently auguring its fatal termination. Such, indeed, are the narrow limits of human foresight, that all men of experience and attentive observation are much more tardy in giving a decided opinion of the result of a disease than the more inexperienced practitioner. How many examples of erroneous prognoses do we not all meet with? and I am convinced, that nothing has contributed more to extend this humiliating catalogue, than the introduction of auscultation.

Injurious influence of auscultation.

The *stethoscope*, it has been remarked, is often employed, not only very unnecessarily, and at an injudicious moment, but even, I regret to say, for unworthy purposes. To arrest a patient's attention to his heart by the formal pedantry of a stethoscopic examination, cannot fail to excite more or less anxiety and alarm; and which excitement alone has a powerful influence on the heart's movements, not only to increase any unnatural motions of that organ, but it may even lead the sick to suspect that they have some serious disease when none exists.

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[*] "Diseases of the heart (says Andral), characterised by the most severe symptoms, are not always without resources. The attention of physicians cannot be too much called to facts of this kind. Complaints of the heart ought to be placed among those affections which, having carried patients as near as possible to the grave, may yet be so remedied as to permit of a long existence."

"A custom," justly observes a popular author, "has long prevailed among physicians, of prognosticating, as they call it, th patient's fate, or foretelling the issue of the disease. Vanity, no doubt, introduced this practice, and still supports it, in spite of common sense and the safety of mankind. I have known a physician barbarous enough to boast, that he pronounced more *sentences* than all His Majesty's judges. Would to God that such sentences were not often equally fatal! It may, indeed, be alleged, that the doctor does not often declare his opinion before the patient. So much the worse. A sensible patient had better hear what the doctor says, than learn it from the disconsolate looks, the watery eyes, and the broken whispers of those about him. It seldom happens, when the physician gives an unfavourable opinion, that it can be concealed from the patient; the very embarrassment which the friends and attendants show in disguising what he has said, is generally sufficient to disclose the truth. We do not see what right any man has to announce the death of another, especially if such a declaration has a chance to kill him. Mankind are indeed very fond of prying into future events, and seldom fail to solicit the physician for his opinion. A doubtful answer, however, or one that may tend rather to encourage the hopes of the sick, is surely most proper. This conduct could hurt neither the patient nor the physician. Nothing tends more to destroy the credit of physic than those rash and unfeeling prognosticators, who, by-the-bye, are generally the most ignorant of the faculty. The mistakes which daily happen in this way, are so many standing proofs of human vanity and the weakness of science.

"We readily admit, that there are cases where the physician ought to give intimation of the patient's danger to some of his near connexions, though even this ought always to be done with the greatest delicacy and caution; but it never can be necessary, in any case, that the whole town and country should know, immediately after the doctor has made his first visit, *that he has no hopes of his patient's recovery.* Persons whose impertinent curiosity leads them to question the physician with regard to the fate of the patient, certainly deserve no other than an evasive answer.

"The vanity of foretelling the fate of the sick is not peculiar to the faculty; others follow their example, and those who think themselves wiser than their neighbours often do much hurt in this way. Humanity surely calls upon every one to comfort the sick, and not to add to their affliction by alarming their fears. A friend, or even a physician, may often do more good by a mild and sympathising behaviour than by medicine, and should never neglect to administer that greatest of all cordials—hope.

"So far, however, is this from being generally attended to, that many make it their business to visit the sick, on purpose to whisper dismal stories in their ears; such may pass for sympathising friends, but they ought rather to be considered as cruel and unprincipled enemies."

Buchan's Domestic Medicine.

CHAPTER XVI.

THE TREATMENT OF THE DISEASES OF THE HEART IN GENERAL.

Importance of this branch of therapeutics; the imperfect classification of medicines; no class has been assigned to cardiacs; cardiac medicines enumerated; general observations on therapeutics; processes of the animal economy to cure diseases; these processes are both mechanical and chemical; these processes are under the influence of a vital principle; examples of these processes in man and in animals; the intimate union between animals and vegetables; animals exhale and excrete the elements necessary for the life of vegetables; vegetables exhale and secrete the elements necessary for the life of animals; the processes employed by the economy for the cure of diseases can be imitated; a system of therapeutics should be founded on these natural processes; this system illustrated by the doctrine of Hippocrates and the older pathologists; its utility in the treatment of the diseases of the heart.

Preliminary observations.

THE treatment of the maladies of the heart is not the least important subject to be discussed in this work. Its details offer a far more extensive field of inquiry than has usually been allotted to them, and, as far as I know, they have never been investigated in a general or comprehensive manner; nor has there been any advancement made on this branch of therapeutics at all commensurate with the progress of physiological and pathological science.

Imperfection of this branch of therapeutics.

Those who have written on particular diseases of the heart have pointed out what they may have considered to be the best modes of treating them; but almost all their observations apply chiefly to its organic affections; whereas, it is in the *functional* disorders of the circulating apparatus where the treatment is so important and so decidedly beneficial. Indeed, I will endeavour to prove that many of the functional disturbances, though they may not have been considered as primary affections of the heart, yet, when such ailments have been relieved by medical treatment, the relief has been obtained by employing those very remedies which have a specific influence on the organs of circulation.

No class assigned to cardiacs.

It is remarkable, that in no work on therapeutics do we find even a *class* assigned to those remedial substances which act directly upon the heart. The significant term *cardiacs* has seldom been made use of, although the word cordial is employed in common language distinctly to denote such a class of substances; and, in place of being arranged together, as those medicines are which act on the nervous, digestive, and biliary systems, on the kidneys and skin, cardiacs will be found classed—some amongst the tonics, some amongst the narcotics, and some amongst the anti-spasmodics.

Value of such a classification.

Indeed, it seems to be inexplicable, how so important a class of medicines as those which have a specific influence upon the heart should not have, like those which act upon other and far less important organs, been grouped together and arranged under one class; affording a very striking proof of the neglect which has been paid to this important branch of the *materia medica*. It appears, therefore, to me, that a class of cardiac remedies might be very properly formed, in which should be arranged the various vegetable, mineral, and animal substances which have a specific action on the central organ of the circulation.

In adopting this arrangement, I am necessarily compelled to differ from the classifications of the *materia medica* which have hitherto been taught. There seems never to have been any fixed principles employed for classifying all the various medicinal substances. Some classes have been formed by selecting for each those substances which produce particular effects upon certain organs or systems of the economy, such as sudorifics and diuretics. But, in other classes, medicinal substances are brought together because they are all supposed to have the same influence on particular diseases, such as antispasmodics, diffusible and permanent stimulants. The consequence is, that there are many substances which belong to several different classes; for not only does the same medicine affect different organs, but its effects are greatly modified, or entirely new effects are produced by different doses. Opium and alcohol, in small doses, exhilarate, and, in larger quantities, cause depression; so that they are both stimulant and sedative. The preparations of iron act as tonics and as astringents, and they are arranged in both these classes of the *materia medica.*

The numerous medicinal substances of which I have subjoined a Table, it will at once be perceived, will be found placed in different classes of the *materia medica;* and, consequently, it may readily be understood that they have, also, influences upon other organs besides the heart and vascular system; and one great difficulty in classifying the objects of the *materia medica* arises from the circumstance, that the same medicine has perfectly different effects when administered in different doses.

But it is of still greater importance, in viewing *cardiacs* as a class, to remember that each of them has its peculiar mode of acting upon the organs of circulation; some of them increasing, and others diminishing the heart's vigour; differences which are caused by the changes which they produce in the nervous system.

And there are also cardiacs which act upon the blood, and by which the vital element is variously changed.

TABLE.

Antimonials
Mercurials
Lead
Silver
Zinc
Copper
Iodine
Alum
Ammonia
Soda
Potash
Alcohol
Ether
Chloroform
Iron
Camphor

Valerian
Myrrh
Assafœtida
Galbanum
Opium
Hyoscyamus
Tobacco
Belladonna
Lobelia
Ipecacuanha
Digitalis
Hellebore
Elaterium
Colchicum
Musk
Castor

General Observations on Therapeutics.

Before entering further upon the important subject of the treatment of diseases of the heart, it has appeared to me that it would be expedient to attempt to give a general view of therapeutic science; and having once established some general principles by which the treatment of diseases should be conducted, we can afterwards apply these principles when pointing out the treatment of the particular diseases of the heart.

To fulfil this purpose, I will endeavour to show that the processes which the animal economy has the power to perform, not only for preserving and restoring its functions when these are disordered, but likewise for the cure of diseases, are a safe guide to pursue in the administration of remedies; that, for the cure of diseases, it is above all things requisite to follow NATURE, and endeavour to aid and assist her in executing these processes, but never to interrupt her efforts. By admitting this as a great general principle for conducting the treatment of disease, we shall find, that all therapeutic agents may be simply arranged, and rules for administering the various remedies be distinctly pointed out.

I will now, therefore, proceed to review in succession these different acts of the economy, after which we shall be prepared to enter upon the consideration of the different means which we possess for imitating these natural processes, and their application in the treatment of the diseases of the heart.

Powers of the economy to regulate the circulation.

The animal economy, I have already shown, possesses powers within itself to preserve, and to restore, the integrity of its various functions when these have been deranged; and, from the constant changes which are taking place in the distribution of the blood to the different organs, whether for performing the functions of nutrition, growth, or life; or the changes which are constantly resulting from the habits of organised beings, it becomes necessary that the economy should have the means to enable it to preserve the due proportion of blood in the different organs. For, although the heart impels the blood into all the arteries with a similar velocity, yet the circulation in them undergoes various changes before it reaches the capillary system;

See page 19.

these changes being produced by different modes in the arrangement of the vessels, and by differences in their modes of distribution in the various organs.

Two kinds of these.

Of these instinctive processes by which the circulation is regulated, one is employed to free the heart from any extra quantity of blood, and the other to increase the quantity of its blood; the one act relieving an oppressed, and the other invigorating a feeble, heart; and these processes are performed by the respiratory and muscular systems—by the *pulmo-cardiac* and the *musculo-cardiac* functions, separately or combined.

One relieves conjestion.

and the other syncope.

The constant changes in the inspirations and expirations, the acts of sobbing, sighing, crying, and weeping, are all and each of them instinctive efforts resorted to for unloading a congested heart, as that which takes place from grief; whereas, by convulsive movements, or by the *musculo-cardiac* function increasing the quantity of blood within the heart, its action is invigorated, as may be observed in persons recovering from syncope, the hysteric paroxysm, and from other fits; the violent convulsive movements in such cases promoting the flow of the venous blood into the right, and impeding the exit of the arterial blood from the left heart.

Involuntary movements from different causes.

Whilst such involuntary movements are employed by the economy for the purpose of restoring disturbances in the circulation, it must also be remarked, that *convulsions* take place under other, and, indeed, very different circumstances, such as from disease or injuries of the nervous centres, or of the nerves emanating from them.

And the almost incessant involuntary movements, so remarkable a feature in *chorea*, which take place in the waking state, and the permanent contraction of the organs of active motion in *trismus*, appear, as far as our present knowledge extends, rather to be the direct effects of disease, than acts of the economy resorted to for the purpose of restoring a disturbed circulation.

These instinctive acts performed by the organs of respiration and circulation are employed, not only for the purpose of preserving that balance of the circulation, which our habits and necessities constantly deranges, but they are also resorted to by the system in those more serious disorders of the heart in which the circulation has suffered some additional causes of disturbance, and which these instinctive acts are sufficient to restore.

Powers of the economy to cure disease.

In disorders wherein those powers of the economy which have been pointed out are not sufficient to restore the circulation, we then find that further means, other processes are resorted to, which, since the very dawn of medical science, have been observed and accurately described, though they appear to me to have received far too little consideration from modern pathologists.

Spontaneous hæmorrhage curative effects of,

Of these, one of the most remarkable is spontaneous *hæmorrhage*, by which process of the economy an accumulation of blood, or plethora of a particular organ, is relieved, and the natural state of its circulation restored. In this manner is a fulness of blood in the head relieved by epistaxis, in the chest by hemoptisis, and in the chylopoetic viscera by the hæmorrhoidal flux.

and likewise of spontaneous vomiting.

No less remarkable are the effects of spontaneous *vomiting*, another process of the economy which is resorted to in disturbances of the circulation, more especially in derangements of the capillaries, whether those of the cutaneous or of the gastro-pulmonary mucous system.

Its curative effects,

The violent muscular movements which accompany the act of vomiting have so powerful an effect on the circulation, that the functions of the capillaries, however much they may have been interrupted, appear to be almost immediately restored by it; so that, in place of coldness of the cutaneous surface accompanying such disturbance of the capillaries, a copious perspiration ensues; after which, the balance of the circulation is completely restored.

and of nausea.

Intimately associated as the act of vomiting is with *nausea*, and though these two processes have effects upon the system which appear to be quite different, yet, as I have already explained, they may either occur separately, or they may be combined together, forming one act.

Nausea, like vomiting, may be observed in many diseases to be employed by the *vis medicatrix*, in order to change the state of the circulation.

Nausea without vomiting we frequently observe accompanying a suppression of the menstrual flux, being then employed for the purpose of regulating the circulation in the heart which, in such cases, is more or less deranged. Thus, it is not unusual to meet with examples of painful or obstructed menstruation, which are preceded by a fit of vomiting, the vomiting ceasing whenever the flux makes its appearance.

And the sickness and vomiting so frequent attendants, and, indeed, so important diagnostic symptoms of an impregnated uterus, are, in all probability, an effort of the economy to restore the balance of the circulation which has been disturbed by the condition of the uterine system.

In *hooping-cough* there is no more favourable sign, and nothing alleviates the severity of the symptoms of that disease more than spontaneous vomiting; and examples are by no means very rare, of persons who have disease of the stomach being in the habit, for a lengthened period, of vomiting after each meal.

The regurgitation of the food in the infant.

In the *infant* we also observe how the economy employs the act of vomiting solely for the purpose of relieving the stomach of superabundant milk, or pernicious food. Infants are frequently in the habit of vomiting some of the milk which they have sucked, when, from too great desire, the stomach had been overloaded; and this habit sometimes continues for a lengthened period without the health of the child appearing to be impaired.

and in the glutton.

The same is told of the *glutton;* that animal, after over-distending his stomach, is said to be in the habit of pressing himself in a convenient situation, such as between the branches of a tree, and thus to disgorge the stomach, in order that he may be again ready for another repast!

And the vomitings which accompany sea-sickness and cholera are all acts of the economy from which some wise purpose must, undoubtedly, be derived.

Vomiting instinctively resorted to by animals.

So great, indeed, is the influence of the act of vomiting in relieving disease, that, in order to produce it, some animals, when unwell, are instinctively impelled to eat substances which cause vomiting; familiar examples of which may be observed in the *dog* and *cat,* they being in the habit of making themselves vomit by eating particular plants.

Such processes are mechanical.

All these means possessed by the animal economy to restore a disturbed circulation are, it may be observed, strictly *mechanical;*

the movements of the parietis of the chest in respiration and in vomiting, the increase in the vigour of the heart by the influence of the *musculo-cardiac* function, and the increase or diminution in the velocity of the streams of blood passing out of and coming into the heart are, doubtless, all physical processes.

Chemical processes employed by the economy.

But the animal economy likewise possesses means by which it can modify and correct the qualities of the fluids when these have been changed by disease; and which processes are considered *chemical*, though under the immediate control of the *vital* principle. It is this vital principle which constitutes that remarkable difference between the processes which are performed in the chemical and in the vital laboratories, or the differences between those of organised and inorganised bodies. What the nature of the vital principle, or nervous power is, we know nothing, and, in the present state of physiological science, we must be satisfied with investigating its laws, and the operations of these in the animal economy.

The vital principle regulates them.

"One of the greatest occupations of man ought to be the discovery of nature's laws, and making them subservient to his use and to his happiness."

The blood changed by them.

We observe such *chemico-vital* processes resorted to when there is a disordered circulation from a change in the qualities of the *blood*. Morbid alterations in that fluid are corrected by processes which are executed either by the digestive, the respiratory, or the cutaneous systems conveying to, and mixing with, the blood, various matters which may have been taken into the stomach, or absorbed by the lungs or by the skin. And noxious matters may be removed from the blood by the organs of *excretion*. Profuse perspiration and diarrhœa, "critical sweats and purgings," the formation of abscesses and eruptions, are all extrementitious processes which are employed by the *vis medicatrix naturæ* for the relief and for the cure of disease.

Instinctive acts employed for these purposes.

To enable the economy to perform some of the processes for restoring the healthy state of the blood, man appears to be endowed with *instincts*, by which he can make choice of such kinds of food and drinks as contain the elementary substances which are necessary in the chemico-vital laboratory, and enable it to form such compounds as may be required for restoring the blood to a healthy state. This impulse prompts man to change his food when suffering from disease, and, however inconsistent or improper the food he selects may appear, the choice is always found to benefit, and never to injure him.

To allow the sick to obey these instincts is a very useful practical maxim; for, when the most accomplished practitioner cannot presume to dictate either the kind or the quantity of food or drink, the sick man can, with confidence, select for himself such as are most palatable and grateful. Hence, amongst the sick, there are some who prefer animal to vegetable food, some salted to fresh meats, some fermented liquors, and others wines; some acidulated drinks, and others give the preference to plain water.

These restorative powers of the animal economy, are no less apparent when a part of the body has been *wounded* or otherwise injured. If the soft parts have been divided, or if a bone has been broken, or an artery wounded, after all such accidents the restorative powers of Nature are strikingly illustrated. What process can be more beautiful than the means she employs to heal a wound of the skin? first arresting the hæmorrhage, by plugging up with a coagulum of blood the mouths of the divided arteries, then hermetically sealing the surface of the wound with a covering of inspissated blood; and finally, repairing the injury by a process of granulation and cicatrization. And what can be a more beautiful illustration of the *vis medicatrix naturæ* than the reunion of a fractured bone by the deposit of osseous matter around the fractured extremities?

We may indeed observe, not only in man, but throughout the whole animal kingdom, that there is an instinct by which every race of living beings are enabled to select each their proper food, and to avoid such as is hurtful to them; and also an instinct which prompts them, when they are suffering from disease, to change their food and choose aliments which they never partake of when in health, and for which they may even have a repugnance.

Wild animals crowd to the *salt* springs which abound in the interior of the vast continent of America; and the *deer* which inhabit the hills and the forests of this country repair, at particular seasons, to the sea-shore, to seek those plants which are strongly impregnated with salt, as well as to drink the sea water.

In some *birds* there is a similar instinct, which impels them to swallow substances, such as small stones or pebbles, for the purpose of aiding their digestion; and the same instinctive powers direct the common *fowl* in the "laying season" to search for *lime*, from which the shell of its egg is to be formed.

What can more strikingly corroborate the existence of these instinctive powers than if what is told by the Egyptian physicians of the habit of the *hippopotamus* be not a fiction? That inhabitant of the Nile is said to have been observed to come out of the river on particular occasions, and trampling his gigantic feet upon the sharp point of a broken reed, to lacerate the skin, from which a bleeding followed; and which he stopped, after it had been sufficiently copious, by plugging up the wound with mud!

Reflections on the intimate union of the animal and vegetable kingdoms.

It is impossible to contemplate all these instinctive acts of the animal economy without being struck with the wisdom and design by which the phenomena both of the animal and vegetable kingdoms are intimately associated and inseparably connected with one another.

Willick on Diet and Regimen. 1809.

"All nature," observes an elegant author, "is united by indissoluble ties—every individual thing exists for the sake of another."

The CREATOR has ordained that there shall be different races of living beings to inhabit this globe, and that each race shall be provided with food suitable to its organisation, and for the purposes which the animal is to serve in the creation, furnished with powers to obtain and instincts to select the food intended for its use, and to reject that which would be hurtful.

Carbonic acid evolved by animals.

Oxygen exhaled by vegetables.

It has also been ordained to be a law of Nature, that the animal and vegetable kingdoms shall be mutually dependent upon each other for their subsistence. Plants, for their nourishment, absorb carbonic acid, being that portion of the atmospheric air which is thrown off by animals, and which is hurtful to animal life; and animals, for their subsistence, inhale oxygen, that being the portion of the air which is evolved by plants.

And a similar interchange takes place between the two kingdoms in their solid food; for whilst the animal lives upon plants, the excretions of the animal, in their turn, become food to vegetables.

These processes of the economy to be imitated in the treatment of disease.

From all that has now been said, it appears to me that a general principle may be established for the administration of remedies legitimately based upon the processes which we have seen are employed by the animal economy to restore functions that have been deranged, and to repair injuries; and that a rational system of therapeutics should consist in imitating these processes, and in endeavouring to expedite or assist, but never to interrupt, Nature's efforts.

In reviewing the various remedial means possessed by the economy, which are employed for the cure of disease, what can more forcibly illustrate this great principle, than the fact, that the effects of each of these remedial means are in strict imitation of one of those natural processes which are resorted to by the animal economy; and that the skill of the physician, in the employment of these remedies, depends upon the sagacity which he displays in selecting and administering them in the appropriate stages of the disease, and according to the peculiarities of each case?

Some of the curative means act mechanically

Of those curative means, as of those processes possessed by the economy, some are mechanical, and some are chemical. Of the first class, or of those which are in imitation of the *mechanical* processes of the economy, are those by which we can increase or diminish the quantity of the heart's blood. We can increase the blood within the heart by muscular exertions, or by artificially stemming the flow of the arterial blood in the extremities of the body by the tourniquet; and we can diminish the quantity of blood within the heart by blood-letting, by abstracting blood from one part of the body to another by the application of cupping-glasses or cupping-boots, or by causing vomiting or fainting by the use of internal remedies.

Others act chemically

In the *materia medica* there are animal, vegetable, and mineral substances, which act chemically upon the fluids, by the exhibition of which we can produce purging, sweating, or an increased flow of urine; and we have, likewise, the means of restoring the qualities of the blood, when these have been altered, by aliments and drinks, as well as by various medicinal substances when taken into the stomach, or absorbed by the lungs or the skin.

The processes of the economy imitated.

Thus, we may infer that the processes employed by the animal economy for preserving and restoring health, may be considered as rational and legitimate guides for the treatment of disease; and, likewise, that we possess agents by which such processes may be imitated.

In confirmation of these views, we have only to consider the sensible effects which are produced upon the body by different remedial means, and so discover the signs for their administration with which we are furnished.

by artificial bloodletting.

What can be a more certain indication for employing artificial *bloodletting* than those uneasy sensations in the head which are symptoms of plethora, and which may have, on a previous occasion, been relieved by a spontaneous bleeding from the nose, or of the propriety of abstracting blood when there is a return of certain uneasy feelings in the chest, with disturbed respiration, symptoms of pulmo-cardiac congestion, and which had on a former occasion been relieved by a copious hemoptisis? or, in fine, of the advantages of bloodletting when there are symptoms indicating a certain condition of the chylopoetic viscera which have been mitigated by the hemorrhoidal flux?

The same remarks are applicable to those diseases which nature relieves by vomiting, by perspiration, by purging, by an increased secretion of urine, by the formation of an abcess, or by an eruption.

by the use of emetics.

The effort of *vomiting*, which marks the presence of some noxious matter in the stomach, is not only a symptom which gives this information, but it points out the propriety of administering an emetic; a practical lesson which has been handed down to us by the Father of Medicine, who made use of emetics in *cholera morbus*, "though in this distemper they had vomited too much already, yet in this case a vomiting was cured by a vomit."

Epidem. lib. v.

and by sudorifics.

Perspirations, likewise, by relieving certain states of the system, an increased heat of the skin becomes an indication of the propriety of administering sudorifics.

and by purgatives.

And so, also, *purging* may be a symptom which, along with some others, indicates that either the mucous membrane of the bowels is inflamed, or that the biliary and other secretions are altered; and it therefore points out the propriety of administering such medicines as may mitigate the condition of the mucous membrane of the intestine, or improve the condition of the biliary or other morbid secretions.

and of artificial discharges.

The formation of *abscesses* are well known to relieve certain states of the system, and point out the use of setons and issues in similar ailments; and *eruptions* are no less effective in relieving diseases, pointing out the propriety of treating such conditions by evacuating and alterative remedies.

Principles of therapeutics.

The view that has been now given of the general principle to guide us in the treatment of disease unfolds an extensive and interesting field of research; and any further observations which I have to offer on the subject, whilst they are more immediately applicable to the treatment of the diseases of the heart, are yet of that general character that they equally apply to the diseases of the other organs and other systems; and will, I hope, be found to elucidate and simplify a branch of medical science which has hitherto been complicated, and is still, in many respects, very obscure.

This therapeutic principle is in accordance with, and, indeed, is chiefly derived from the doctrines of some of the older pathologists; and if the phenomena of the animal economy which I have pointed out admit of the explanation that has been given, the influence which mechanical, as well as chemical processes, exercise in disease must also be granted, and the propriety admitted of placing in these classes all the means which are employed for the cure of diseases.

By adopting this principle we shall find, that the various remedial agents which are applicable to the treatment of the diseases of the heart can be systematically arranged; and, indeed, I may also remark that there is no system of the economy where this therapeutic principle can be so satisfactorily illustrated as in the organs of circulation.

Pathological doctrines of the schools.

In prosecuting our inquiries on this most important branch of medical science, it behoves us to glance over some of those systems which have been taught in the schools of physic, and I think it will appear that, although the doctrines of each system, contemplated as a whole, may be objectionable, yet materials may be gleaned from all of them by which essential aid is to be obtained in forming a rational system of therapeutics.

"All physic," says Hippocrates, "has been long since established; and the method and way of discovering, as they have already done, several excellent things which assist to discover several others, if the inquirer be fitted for it; and being acquainted with the former discoveries, follows the old track: he that rejects all that has been done before and takes another road in his inquiries, boasts of finding out of new things, but deceives himself and others with him." De Prisca Medicina.

Of these systems of physic I allude chiefly to that of the mechanical, the humoural, and the chemical, and to the doctrines of Stahl.

The mechanical and chemical pathologists.

It was the discovery of the circulation of the blood which led to the mechanical doctrines, upon which the system of one school was founded; and the disciples of the humoural and chemical pathologists adopted, in their turn, those doctrines by which they attempted to explain all the phenomena of diseases, and lay down principles for their cure, by producing changes in the qualities of the *fluids*.

Observing the natural or instinctive processes of the economy to relieve the system in disease, Stahl founded his system, and taught the doctrine, that NATURE cured all diseases; and that the whole animal economy was governed by the "soul of man,"—a doctrine, however, which may be found in the works of the Father of Medicine, who considered NATURE as the "directress of the whole animal economy."

Doctrine of Hippocrates.

To this, which Hippocrates called "Nature," he ascribed a mighty power: "Nature is of herself sufficient to every animal, and that in all respects she performs every thing to them, without needing the least instruction from any one how to do it." And again—"It is this faculty which gives nourishment, procreation, and growth to all things."

Of that doctrine which teaches us to take NATURE as our guide, or to trust alone to her efforts, enough has surely been said to prove how much the practice of the healing art is to be directed by a comprehensive knowledge of the various means which the animal economy possesses for the cure of disease.

Cullen's Materia Medica.

"In how many instances," observes the learned Cullen, "the effects of the operations of Nature have been falsely imputed to the operations of medicines need hardly be said. From the first beginning of physic to the present day, it has been generally supposed that many diseases are cured entirely or chiefly by the operations of Nature; and that many of the cures, supposed to be effected by medicine, are often effected by Nature alone."

Errors of the disciples of Stahl.

But, in confiding alone to the powers of the animal economy for the cure of disease, the practice of the disciples of Stahl became inert, they being no doubt led to neglect the use of some of the most powerful remedial means employed by the disciples of the other schools, the supposed effects of these remedies not according with the general principles which they had adopted; neither could the effects of such remedies be explained by the vague theories and hypotheses upon which the humoural and chemical pathologists had built on erroneous physiological doctrines. "Trusting alone to Nature may induce too much caution, but it corrects rashness."

Cullen.

Their doctrines rational.

From what has been said it will appear, how well-founded have been some of the doctrines of the older pathologists, and however much these doctrines may have been disregarded by the moderns, yet it seems to me impossible, either to give a satisfactory explanation, or to establish any sound principles for the treatment of diseases without admitting the validity of, and adopting, some portions of each of these systems, but, more especially, of that system which is built upon the powers which the animal economy possesses to cure disease; that doctrine for which, as I have said, we are indebted to the Father of Medicine.

How the processes of economy are to be imitated

Having premised these observations on the powers which are possessed by the animal economy for curing disease, we are next led to inquire into the means by which these processes can be *imitated*, the whole art of the practice of physic being to select and administer these remedies at the proper periods of the disease.

It has been pointed out, that the mechanical and the chemical processes of the animal economy have but an imferfect analogy to those of dead matter; and as such differences are produced by the agency of the *vital* principle, we must not anticipate that, in the treatment of disease, much aid will be derived from the use of remedies which are either purely mechanical or chemical, or, at all events, that when such curative means are successfully employed, they can only act along with, or under the guidance and control of, those vital powers which regulate the healthy functions.

Indeed, when looking back to the period when any of these remedies were first employed, we almost invariably find, that a knowledge of their curative powers had been quite accidental, and that it was not until long after their remedial effects had been well ascertained, that chemical and physiological science gave a rational explanation of their modes of action.

The mechanical processes.

The *mechanical* means, also, to which I have alluded when explaining the phenomena connected with respiration and circulation, had been long known, and yet the various instinctive acts by which they are modified, and by the imitation of which disturbances in the circulation are alleviated, were in use long before the nature of these instinctive processes of the economy were understood.

and the chemical processes.

And it is the same as regards the *chemical* remedies; for, in scarcely any instance, does it appear that the chemical philosopher has been the first to point them out; he having only explained their action after their utility in the treatment of disease had been long and incontrovertibly established.

All the processes of the economy cannot be imitated.

The chasm seems, indeed, to be so wide, and the differences in the processes which are performed in the vital and in the chemical laboratories so great, it is not reasonable to expect that we shall be able to imitate the one by any knowledge which we may ever acquire of the operations of the other.

One essential difference, however, chemical science has revealed between those matters compounded in the vital laboratory that are absorbed into the body, and those which are discharged from it; or between the incrementitious and the excrementitious compounds; the first of which cannot be imitated by any chemical process, whilst the latter resemble the compounds of inorganized matter.

There are, as I have said, few diseases the principles for the

Chemical remedies accidentally discovered.

treatment of which have been, originally, the result of the application of chemical processes. Certain states of the *urine* may be relieved by the exhibition of chemical remedies; but, generally speaking, almost all the morbid changes of that excretion are the effects of imperfect digestion, and by curing which, the natural properties of the urine are restored.

In diseases of the blood, chemical agents have a decided effect, of which the preparations of *iron* is a remarkable instance; and as modern chemists have shown, that the healthy blood also contains minute portions of copper and lead, it is very probable that the good effects of sulphate of *copper* and acetate of *lead*, so long employed in the treatment of the diseases of the circulation, may also be satisfactorily explained.

Millon.

The powerful effects of *alkalis* in the treatment of rheumatism, gout, and scrofula, in changing the qualities of the blood, have been known from a very early period of medical history, and we are indebted to chemistry only for an explanation of the chemical changes which such substances produce on the blood. And, in the history of the medicinal effects of *iodine*, the use of burnt sponge was known for the dispersion of morbid growths long before chemical science explained the nature of the remedial element which the sponge contains.

But the triumph of our art in assuaging human suffering has been the discovery of the extraordinary effects of the inhalation of *ether*,—a discovery which has conferred the greatest blessings on mankind; but for which we are not, however, indebted to the chemists, although chemical science has since extended and improved our knowledge of anæsthetic agents.

"The physician ought not to be ashamed to inform himself, though by the meanest people, of remedies confirmed by experience. By this means, in my opinion, the art of physic grew up by degrees, that is, by amassing and collecting observations of the several particular cases one by one, which, being all put together, make one entire body."

Præceptiones.

CHAPTER XVII.

GENERAL OBSERVATIONS ON THE MODE OF ADMINISTERING REMEDIES.

Difference in the effects of the same medicine in different persons and at different times; causes of these differences; errors in the mode of estimating the doses of medicine; remarkable effects of small doses; the order in which medicines should be administered; effect of combining different medicines: the accumulative effect of medicines; the effects of changing medicines; discordant opinions of the effects of medicines, and of their different doses; how such discrepant opinions are to be reconciled.

Previously to considering the particular remedies employed in the treatment of diseases of the heart, there are some general observations which it may be useful to make upon the mode of administering medicines, as such observations will be found equally applicable to all the diseases of this important organ.

Subjects here treated of.

I allude to the effects of medicines on different persons; to their different doses; to the order in which they should be administered; to the effects of their different combinations; to their repetition; to their cumulative effects; to the effects of changing one for another of the same class; to the discordant opinions of the effects of them, and to their proper doses; all which are points well worthy of a separate consideration.

Here it may be mentioned, that the observations which I have to offer on the treatment of the diseases of the heart, must be considered as the result of a long experience and careful observation on a multitude of cases of disease, amongst all branches of the community.

Observation of Cabanis.

By nothing is the young practitioner of medicine more apt to be misled, than by having general rules laid down for conducting the treatment of disease, when those rules have been derived from observations made only on a particular class of people. It has been justly remarked by Cabanis, that "the practice of medicine is reduced to a few simple rules in the country and in hospitals; but it is obliged to multiply, to vary, and to combine its different recourses when applied to men of letters, to artists, and to all persons whose lives are not devoted to mere manual labour." This rule is, in a special manner, applicable to disorders of the heart, most of the diseases which affect the "working classes" of the community being of a perfectly different character from those whose avocations are chiefly intellectual, or who indulge in habits of idleness and dissipation.

Causes of differences in the effects of the same medicine.

It is of importance to be aware, that very different effects are produced by the same medicine when given to different persons, under apparently the same circumstances; and this observation also applies to the same medicine when administered at different times to the same individual. "The medicines which agitate in health may soothe in disease." Hippocrates.

So, likewise, it is of consequence to mark the proper time to discontinue the use of a particular medicine. That medicine which will produce a most beneficial influence when disease is present, will be equally injurious to the same person when in health; and, therefore, when such remedy has been continued long enough to cure the disease for which it was prescribed, its longer continuance may become injurious. Many persons with whom opium, calomel, and other medicines, disagree when in health, or when suffering only under slight ailments, derive every benefit from their use when they are afflicted with a severe indisposition. A lady who never could take a dose of mercury without great derangement of the whole system, was attacked with *peritonitis*, and her pulse sunk after losing a few ounces of blood. I gave her a dose of calomel and opium every few hours, by which the inflammatory symptoms were rapidly subdued; but after they had abated, the continuance of the mercury was followed by all its former pernicious effects. Case.

It is the same with antimony; and in administering this medicine in disorders of the heart, it will be found, that whilst essential benefit is derived from it, and it has occasioned neither sickness nor nausea, at least, when the condition of the circulation for which it was administered is relieved, then, and not till then, does it occasion derangements in the digestive apparatus.

This subject might, indeed, lead to a lengthened discussion; but it may be sufficient here to remark, that all our remedial means which are employed for the cure of disease may perform that office effectually; but if continued after the symptoms have been subdued, or when the body is in health, they have effects upon the system equally injurious. This may be observed in the treatment of the heart's diseases, where mercury is employed in the first stages of some of its inflammatory affections; when the continuance of that medicine often produces injurious effects.

How the effects of medicines are altered.

It is extraordinary how the effects of medicines are changed by apparently trifling differences in their quantity, in their combinations, in the condition of the stomach, and in the period of the day when they are administered; and hence, the discrepancies in the opinions which have been promulgated, of the effects of the same medicine, may often be satisfactorily accounted for; and a knowledge of such differences is of essential utility in the practice of the healing art.

Erroneous mode of estimating the doses of medicine.

An erroneous, though a very common mode of reasoning in administering medicines, is to suppose, that if a certain dose of a remedy produces certain effects, these effects will be *doubled* if the quantity of the medicine be doubled. It might, I think, be advanced as a general maxim, that quite the contrary usually takes place, and that whether a particular dose be increased or diminished, not only are the effects different, but entirely new effects are produced.

What can be more illustrative of this observation, than the differences so well known in the effects of small or large doses of opium, or alcohol, the small dose invigorating the system, and the large dose depressing the animal powers. It is the same with calomel, aloes, and with many other medicines. One grain of calomel will often purge the bowels violently, whereas five, or even ten grains of that medicine are often administered to relieve diarrhœa; and very large doses of aloes have commonly very little sensible effect on the digestive canal, whilst a single grain acts as a powerful evacuant.

There is much difficulty in establishing the precise doses of medicines; and attention must be paid solely to their sensible operations, disregarding altogether any preconceived opinions of what may be the effects of any particular quantity. Very unforeseen effects of medicines are sometimes discovered from very large or very small doses being accidentally administered; or from medicines being continued much longer than was ever intended.

Case. A house-painter, who had an ulcer on his leg, and whose general health was considerably deranged from habits of dissipation, was ordered a dozen of pills containing in each two grains of calomel; and I did not again see him until fifteen months afterwards, when he informed me that his leg soon healed after taking the pills, and that he had taken one every day since!

Case. To show how little effect may be produced upon the system by large doses of some medicines, I may mention the case of a young lady who swallowed no less than *seven drachms of calomel*, six of which were afterwards separated from the alvine discharge in so pure a state that her medical attendant afterwards administered it to other patients, on some of whom it produced salivation.

Efficacy of small doses. This leads me to make an observation which will be found of very general application,—that for the cure of diseases *small* doses of drugs are generally more useful than *large* doses. I mean, that small doses, whatever the medicine may be, are more effectual in the cure of many diseases than the same medicine when used in large quantities.

Without going further into this question, I will merely remark, that wherever medical treatment has been found most beneficial, the relief has been usually obtained, not from large doses or large quantities of a medicine, but from small quantities and small doses; at least this is the result of my own experience. And what can illustrate this more strikingly than to witness the cure of some long-standing syphilitic eruption by giving one tenth part of a grain of corrosive sublimate every second day for a couple of months in a case which had resisted both large doses and long-continued courses of mercury? How often do we find, that small doses of purgatives act freely on persons on whom large doses of the same medicine have comparatively little effect. The successful practice of Haygarth, who gave five grains of bark for the cure of rheumatism, in place of the usual dose of half a drachm or even a drachm of that medicine, is another illustration of the same principle.

And it is the same with regard to *iron;* small doses of its preparations appear to have more effect than those which are much larger, in all probability this difference arising from the absorbents taking up only small portions, and rejecting the larger.

Effects of the combination of medicines.

Besides differences in the effect of medicines from differences in the dose, essential differences are also caused by administering them *combined* with one another,—effects which cannot be explained and which nothing but practical observation can determine.

Order in which medicines ought to be given.

There is no point deserving more attention in the administration of medicines than the *order* or succession in which they ought to be given; for, if this be disregarded, their effects are often completely changed. A blister has a very different effect after blood-letting than before it; and opiates produce a very different influence on the system before than they have after the bowels have been evacuated. "There be many medicines which by themselves would be no cure, but perhaps hurt; but being applied in a certain *order*, one after another, do great cures."

Bacon.

Further, the *accumulated* effects of medicines ought to be kept in mind in conducting the treatment of diseases of the heart; and although not much has been said on this subject in works on therapeutics, the fact is well-known to many men of experience: and, from not being acquainted with this circumstance, instances are not rare where a great many doses of purgatives have been taken with but little sensible effect, until after a certain number of days have elapsed, when suddenly they act violently, and often to a hurtful extent; and the same has often been observed as regards *digitalis*.

Medicines may be changed advantageously.

Here I may allude to the benefit which is sometimes to be derived from *changing* the medicine in the treatment of many diseases of the heart; by which is to be understood, that when the beneficial effects of one medicine appear to cease, another of the same *class* may be successfully resorted to; as, for example, the preparations of iron may be replaced by those of copper or of zinc, the effects of all these preparations upon the circulation being very analogous.

"It helpeth, both in medicine and in aliment, to change, and *not* to continue the same medicine or aliment still."

Bacon.

Discordant opinions of

Another observation may be opportunely made here, as it may be useful to the younger members of the profession; that when the effects of medicines, how caused.

for the treatment of a disease there are several *different* modes recommended which appear to be so opposite and so incompatible with one another, that he may be induced to suspect the accuracy, or even the veracity of the observers; whereas, if he should have the opportunity to witness the treatment of any particular disease conducted by several physicians, a difference more or less remarkable would be observed in the detail of the practice of each, though the general principles adopted would be the same, and the result of each mode of treatment be equally satisfactory.

In the administration of medicines, experience and personal observation alone must be our guide, and we must be satisfied with knowing the particular effects that each medicine produces on the different organs, without attempting to explain these; for what can be more inexplicable than the influence of ipecacuanha on the stomach, aloes on the rectum, mercury on the liver, belladonna on the iris, and digitalis on the heart?

How or in what manner these act upon the different organs, and what changes they produce in the vital laboratory, has hitherto evaded research. It is true, some have a direct influence upon the nerves of the stomach; others appear first to exercise their influence upon the cerebro-spinal system; others must be first mixed with the blood; some affect only a particular organ; but of the laws by which all these varied changes are governed we are totally ignorant.

The local and general treatment.

In the treatment of the diseases of the heart, as in those of all other organs, it is most essential to consider both the *general* and the *local* treatment, and the order in which the remedies of both classes should be employed.

The greatest caution is always required in the use of local remedies; and in most instances they are far more frequently hurtful than beneficial.

This has seemed to me usually to arise from the attention of the practitioners being chiefly arrested by the local symptoms, and to the sick being always inclined first to apply some remedy to a pained part. Whereas, it is of the greatest importance to endeavour in the first place to mitigate the *general* symptoms, and when these are subdued, local remedies may be advantageously, and never dangerously, employed; for when the local symptoms are subdued without such previous general treatment, it then often happens that some internal mischief remains.

And hence, in the treatment of the heart's diseases, it is not only essential that we have discriminated and distinctly traced the primary affection to have originated in the heart, but it is equally essential that the condition of the other systems which are deranged be accurately noted; for, in all cases, it becomes a nice question to determine the order in which the remedies for each should be employed, as before commencing the use of cardiacs, it may be necessary to improve the condition of the digestive organs, by evacuating any morbid secretions collected in the alimentary canal.

Channels by which medicines are administered.

The mode in which medicines are exhibited is also an important consideration in the treatment of diseases. Some can only be given in a solid, and some only in a liquid form; besides, some may be absorbed by the skin, or by the gastro-pulmonary mucous surface; and all these different modes have each their advantages.

The absorption of medicines, and their peculiar influence on different portions of the gastro-pulmonary mucous surface are worthy of remark.

Nothing is more striking than the effects of some medicinal substances when put upon the tongue, when that can be accomplished in the form of powder; and repeated observation has satisfied me, and I am confirmed by the practice of others, that calomel, tartrate of antimony, and other medicines, not only act much more speedily, but a less quantity is necessary to produce the same degree of effect than when taken in any other manner; and that there should be such a decided difference in the effects of different modes of their exhibition is not surprising, when we consider the intimate relation between the tongue and the stomach; changes in the colour, bulk, and form of the tongue, affording some of the most certain signs of the condition of the digestive canal.

For the treatment of diseases, it may be remarked, that the remedies are extremely few. Though the number of different medicines be great, yet many of them have effects nearly similar on the human body. It will, therefore, be found, that those who have longest and most successfully practised medicine, use a much less variety of drugs than the junior branches of the profession; and hence, also, it may be observed, that in proportion as a case is accurately or imperfectly understood, so are the prescriptions simple or complicated. It is the same in all the other arts of life,—the most skilful and the most dexterous mechanic always making use of the fewest implements.

CHAPTER XVIII.

GENERAL OBSERVATIONS ON THE REMEDIES EMPLOYED FOR THE TREATMENT OF DISEASES OF THE HEART.

The remedial means are in strict imitation of the curative processes employed by the animal economy; they are either mechanical or chemical; influence of modifications in respiration in disorders of the heart; how these are produced by limiting the respirations; by quickening respiration; by artificial respiration; by swinging and rotatory motions; effects of exercise and of rest; the curative effects of emetics and nauseants in disorders of the heart; curative effects of abstracting and of diminishing the quantity of blood; the excrementitious and the incrementitious processes; the curative effects of purgatives, of hepatics, of sudorifics, of expectorants, of diuretics, of emmenagogues, and of derivatives, in diseases of the heart.

We come next to consider the application of the different remedies which we possess for the treatment of the diseases of the heart, the effects of all which, as I have already pointed out, are in strict imitation of those processes which the economy itself employs for the cure of disease; and I may here observe, that there is no organ or system of organs where the application of these remedial means can be so amply illustrated, and their practical utility so satisfactorily shown as in the treatment of the diseases of the organs of circulation.

The mechanico-vital processes imitated.

These processes of the animal economy, I have endeavoured to show, are either mechanical or chemical, under the influence and control of the nervous system, or of a vital principle; and, in discussing the various means by which such processes can be imitated, let us first consider those which are mechanical, and which may with propriety be designated *mechanico-vital* processes.

Modified Respiration.—The heart being a mechanical apparatus, especially intended to propel the vital fluid throughout the system, we can readily comprehend how some of its functions may be either disturbed or restored by mechanical processes; and hence we find, that the respiratory apparatus performs an important office, not only in remedying temporary disturbances of the circulation, but also, when these are diseased, creating disorders of the heart.

by changes in respiration.

I have explained how the circulation is changed by those various changes in respiration which are resorted to instinctively by the animal economy, not only to relieve temporary disturbances to which the circulation is subject, but also by the *vis medicatrix*, to restore the balance of the circulation in some of those derangements which are caused by diseases in the heart. Now, these acts which Nature employs, point out the principles on which the most rational artificial means of treatment should be conducted, and, indeed, the great influence which modifications in respiration have on the action of the heart opens an interesting field of inquiry, pointing out a channel for relieving disturbances in the circulation which has not met with that consideration which it so well merits.

The means of imitating some of these processes of the economy by which disturbances of the circulation are restored, consist in those by which either the inspirations or the expirations can be shortened or prolonged.

The *inspirations* may be shortened by keeping the mouth shut, thus inspiring only through the nostrils; or by placing a belt round the chest, so as to prevent the expansion of its parietes; and respiration may be variously modified by swinging and by rotatory motions; by sea-sickness, emetics, and sternutatories.

Some of the natural processes cannot be imitated.

But whilst some of the mechanical processes employed by the animal economy can be imitated, there are others which are beyond the reach of art. We have no remedial means which imitate sobbing, sighing, laughing, crying, or coughing, though, as I have endeavoured to explain, all these acts are employed by the economy, and have a distinct effect in relieving temporary disturbances in the circulation.

See page 71.

Curative effects of limiting inspiration.

There are some disturbances in the heart which can be relieved by *limiting* the inspirations.

I have formerly shown that it is necessary in the healthy condition of the thoracic viscera to inflate the bronchi only to a certain extent, in order to preserve the free circulation in the pulmonary capillaries; and that if the air-cells be distended beyond such limits, the circulation of the capillaries will then be obstructed, and pulmonary congestion will necessarily follow. See page 68.

In order, therefore, to prevent the air-cells from being too much distended, if the mouth be kept shut during inspiration, a very considerably less expansion of the chest is produced than what takes place when a full inspiration is made with the mouth open.

Modes of limiting the inspiration.

This interesting anatomical fact, described by Home, which has hitherto been quite disregarded by pathologists, affords not only a satisfactory explanation of certain contrivances which have been resorted to for enabling persons to perform bodily exertions, but also explains the operation of those means which experience has taught afford relief in some ailments of the chest.

by shutting the mouth.

For running a race, as has been already remarked, it is the usual practice for persons to keep a pebble or some such substance in their mouth, which has the effect involuntarily of keeping it constantly shut, and I have mentioned a person who had a great reputation for teaching elocution, and who taught the student to acquire the habit of reading aloud for a lengthened time by keeping the mouth shut during each *inspiration*, so that in both cases the inspirations were limited and the bronchi prevented from being so much distended as to cause any obstruction to the circulation in the pulmonary capillaries. See page 70. To effect a similar purpose, those suffering from a disordered circulation, and more especially those who have particular kinds of coughs, resort to various contrivances, the *modus operandi* of which can be satisfactorily explained. The influence of limiting the inspirations on the action of the heart may be also illustrated by the good effects of lozenges, so commonly made use of to relieve coughs; for the necessary consequence of the mouth being kept shut by a lozenge is, that breathing is carried on through the nostrils only, and thus the air-cells of the lungs are not sufficiently distended to impede respiration, which would happen, if the inspirations were more full and complete by air being also admitted through the mouth.

Case.

A gentleman who had an embarrassment in his breathing, kept a pebble in his mouth for fifteen months, from which he experienced great relief.

by applying a bandage round the chest.

Inspiration can also be limited by applying a belt or *bandage* round the waist, sufficiently tight to prevent the expansion of the chest during inspiration,—a practice not unfrequently adopted by persons who are about to make great muscular efforts; and it may also be employed to relieve disturbances in the heart.

Case recorded by Dr. Gibbs, of Clifton.

bandage chest

"A bandage was applied pretty tightly round the chest and part of the abdomen, in a patient whose respiration was very laborious, and who had been bled and had tried other remedies for three days previous. The breathing became gradually more easy; and in the course of twenty-four hours it became so easy, that the patient could walk gently about the house. The young woman, who was about twenty years of age, had enjoyed good health until a week before the dyspnœa commenced."

Influence of full inspirations.

The relief in breathing which is obtained by limiting the inspirations is directly opposed to that relief which is obtained in certain affections of the head, in which one of the most remarkable features is, very full inspirations accompanied with deep sighs.

See page 58.

I have already shown, that, by the act of *inspiration*, the return of the venous blood to the lungs is accelerated, the expansion of the chest causing it to be pressed forward by the agency of the atmospheric pressure into the veins of the right heart; thus assisting the circulation in both *cavæ* veins. But when, from any cause, a preternatural quantity of blood stagnates within the head, the inspirations then become lengthened, which, by still further increasing the velocity in the current of the venous blood, causes any superabundant quantity to be abstracted from the brain.

On this principle can be explained the temporary relief obtained in some head-aches by protracted and very full inspirations, and the involuntary long inspirations and deep sighs which are frequently observed in those suffering from disease of the brain, and which would, undoubtedly, facilitate the return of the venous blood from the head.

See page 71.

Cases of diseased heart have already been alluded to, where, by

Curative effects of modifications in respiration.

modifying the breathing, temporary disturbances in the circulation could be restored; so that it is easy to comprehend how irregularities in the heart's action may often cause changes in respiration, and how, by these changes the hurtful effects of the irregular action of the heart in altering the supply of blood to particular organs are thus warded off.

Effects of sternutatories.

The effects of *sneezing* upon the action of the heart, and of the remarkable consent between the organ of smell and the central organ of the circulation I have already pointed out; and it has also been mentioned, that the act of sneezing sometimes appears to be a symptom of a disturbed circulation. On the other hand, particular smells cause a disturbance of the heart; so that the reciprocal influence of these two organs explains the remedial effects of *sternutatories* on the circulation.

Effects of singing;

I have mentioned the case of a lady with a disordered heart, who had frequently been attacked with syncope, and who accidentally discovered that she could ward off a paroxysm by an alteration in breathing, which she made by the effort of *singing*.

and speaking.

A youth with an irritable heart was often attacked with *fits*, and when he was warned of their approach he used to be able greatly to mitigate the paroxysm by repeating a few sentences in a subdued tone of voice.

Curative effects of swinging.

The deranged state of the heart which is present during an hysteric paroxysm has been relieved by modifying respiration by the motion of *swinging*.

Cases recorded by Mr. Crocker.

"A young lady affected with hysteria thought of a remedy for herself to check the convulsive fits. Whenever she felt intimation of an approaching attack, she instantly repaired to the garden, where there was a swing fixed up; and swinging invariably relieved her. She had been carried to it, even in the midst of a paroxysm, when it might have been thought impracticable, from the violent agitations; yet the moment the swing was put in action the paroxysm ceased."

This remedy was adopted by Mr. Crocker in a case of hysteria in a girl nineteen years of age. "She was taken out of doors to the swing in a child's chair, on account of her being partly deprived of the use of her lower extremities; and it was found

Gazette of Health, 1826.

that the action of the child's chair had an effect almost similar to that which the swing had in the other patient."

Curative effects of artificial respiration.

When the action of the heart has become extremely languid, or when it has even ceased to beat, as in some cases of syncope and asphyxia, its action may be restored by *artificial* respiration, employing, at the same time, those means which invigorate the heart's action, such as the administration of alcohol and ammonia, and the compression of the arteries of the extremities.

Such, indeed, is the influence of respiration on circulation, that we have it in our power to produce very considerable changes in the action of the heart, either by quickening or retarding respiration.

See page 71.

Case.

John Hunter, we are told by his biographer, on one occasion, when both respiration and circulation had for some time ceased, saved his life by making a powerful effort to respire. After having taken a dose of laudanum, whilst he was walking about the room, he cast his eyes upon the looking-glass, and observed his countenance to be pale, his lips white, giving the appearance of a dead man. This alarmed him, and led him to feel for his pulse, but he found none in either wrist: he now thought his complaint serious; several physicians of his acquaintance were sent for, but none of them could find a pulse; the pain still continued, but he found himself at times not breathing. Being afraid of death soon taking place if he did not breathe, he produced the voluntary act of breathing by working his lungs by the power of the will; the sensitive principle, with all its effects on the machine, not being in the least affected by the complaint. In this state he continued for three quarters of an hour, in which time frequent attempts were made to feel the pulse, but in vain; however, at last the pain lessened, and the pulse returned, although at first but faintly, and the involuntary breathing began to take place."

Artificial breathing has been employed to restore life when apparently extinguished from a want of power in the heart to circulate the blood.

In asphyxia from drowning, hanging, or breathing noxious gases, artificial respiration is a most powerful restorative process;

and when the heart's action is destroyed by poisons, artificial respiration is no less useful in restoring animation.

A remarkable example of a man, "dead in appearance," and in whom no pulse in the heart and in the arteries could be distinguished, from having breathed a noxious gas in a coal-pit, was completely resuscitated by artificial respiration.

Case recorded by Mr. Tossach.

"The colour of the skin of his body was natural, except where it was covered with coal-dust; his eyes were staring open, and his mouth was gaping wide; his skin was cold; there was not the least pulse in either heart or arteries, and not the least breathing could be observed; so that he was in all appearance dead. I applied my mouth close to his, taking hold of his nostrils with one hand, and holding my other on his breast at the left nipple; I blew my breath as strong as I could, raising his chest fully with it, and immediately I felt six or seven very quick beats of the heart; his thorax continued to play, and the pulse was felt soon after in the arteries. I then opened a vein in his arm, which, after giving a small jet, sent out the blood in drops only, for a quarter of an hour, and then he bled freely; in the meantime, I caused him to be pulled, pushed, and rubbed, to assist the motion of his blood as much as I could; washed his face and temples with water, and rubbed *sal volatile* on his nose and lips. Though the lungs continued to play, after I had first set them in motion, yet for more than half an hour it was only as a pair of bellows would have done, that is, he did not so much as groan, and his eyes and mouth remained both open.

"After about an hour he began to yawn, and to move his eyelids, hands, and feet; I then put water, into which I had dropped some *sal volatile*, into his mouth, which he swallowed, and caused him to be carried into a house hard by, where I set him in a chair, reclining backwards. In an hour more he came pretty well to his senses, and could take drink, but knew nothing of all that had happened after his lying down at the foot of the ladders, till his waking as it were in his house.

"Within four hours he walked home, and in as many days returned to his work."

Edinburgh Medical Essays, 1744

Here it may be noticed, that besides the mode of restoring respiration by inspiring into the mouth, or by inflating the lungs through the nostrils with a pair of bellows, the thorax may be alternately compressed and expanded by pressing it with the hands, the elastic nature of the materials of which it is composed being sufficient to cause its subsequent expansion.

The movements of the chest during the act of vomiting have also been had recourse to as a means of restoring respiration; and an emetic is used by coal-miners, to relieve the *asphyxia* which is caused by breathing impure air.

Holland's Notes and Reflections.

So powerful is the effect of respiration on the action of the heart, that artificial breathing has been successfully employed for restoring animals in whom life had been apparently destroyed by poison, for the purpose of curing disease, the poison having been administered to destroy animation during a sufficient length of time to arrest the progress of the disease.

United Service Journal, 1839, p. 237.

How far it may ever be expedient to imitate such experiments, and extinguish human life for a while, in order to cure diseases, and restore it again after the disease is subdued, is a matter of grave consideration. At the same time, we cannot help being struck with the use that has been made of *chloroform*, the effects of which closely approximate to the experiments made with the *wourali* poison. The approximation is the more remarkable, when we consider that this poison is a compound, of which one of the essential elements is the *red ant*.*

"The experiment of resuscitation having succeeded, it was very natural to suppose that efforts would be made to turn it to advantage; for it was conjectured that, if existence could be destroyed and restored again, the destruction of existence might also remove local or organic disease, and the artificial respiration produce a new life in every sense of the term. The first trial of this was made by Mr. Sewell, an eminent veterinary surgeon of London, on a horse labouring under *tetanus* and locked jaw. The poison was inserted in the fleshy part of the shoulder, and in ten minutes apparent death was produced. Artificial respiration was commenced, and persevered in for four hours, when reanimation took place, and all symptoms of the *tetanus* were cured." United Service Journal, 1839.

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* "A day or two before the Macoushi Indian prepares his poison, he goes into the forest in quest of his ingredients. A vine grows in these wilds which is called *wourali*. It is from this that the poison takes its name, and it is the principal ingredient. When he has procured enough of this, he digs up a root of a very bitter taste, ties them together, and then looks about for two kinds of bulbous plants, which contain a green and glutinous juice. He fills a little quake, which he carries on his back, with the stalks of these; and, lastly, ranges up and down till he finds two species of *ants*. One of them is very large and black, and so venomous that its sting produces a fever; it is most commonly to be met with on the ground. The other is a little *red ant*, which stings like a nettle, and generally has its nest under the leaf of a shrub."—*Waterton's Wanderings in Guiana.*

Exercise.—As involuntary muscular movements are one of those means employed by the *vis medicatrix naturæ* in order to invigorate the heart, the beneficial as well as the hurtful effects of the different kinds of exercise in those who are afflicted with maladies of the heart, may be satisfactorily explained. See page 50.

In a fit of *syncope*, and also in other paroxysms, convulsive movements take place towards their terminations, the musculo-cardiac function increasing the quantity of blood within the heart, and thus restoring the vigour of the circulation: and for the same reason the muscular movements which are made in the various kinds of exercises produce their good effects by increasing the blood in the heart, and consequently its vigour.

"Gymnastic Physick" was inculcated as a useful branch of the healing art by the earliest physicians. Esculapius ordered "some to ride on horseback, and to exercise themselves in their arms; and he showed them the several sorts of motions they were to express, and after what manner they were to be armed."

But when the heart is disturbed, all those exercises, so useful in preserving health, now become more or less injurious.

And every movement which tends to increase the quantity of the heart's blood, ought especially to be guarded against by those who suffer from a disease of the heart. Medical records abound with cases of persons with cardiac disease dying suddenly from some inordinate muscular exertion, or violent mental excitement: these, either causing a congestion of blood which the diseased heart could not evacuate, and in many instances even rupturing the heart's parietes. See page 120. John Hunter, who had a diseased heart, dropped down lifeless when in a violent passion; and Abercromby expired from a rupture of the right auricle whilst making an effort to evacuate the bowels!

Rest.—Bodily tranquillity is of essential utility in the treatment of diseases of the heart. The action of the heart being increased by the slightest muscular movement, the influence of the perfect repose of the muscular system must be a useful curative means in many diseases of the circulation.

The system of treating *aneurism* recommended by Valsalva has much of its benefit derived from the perfect rest so strictly enjoined along with the depletive system; and I am convinced that in many diseases of the heart much benefit may be derived by perfect bodily repose, whilst there is nothing more remarkable, in almost every disorder of the heart, than the pernicious effects of muscular exertion.

Bloodletting.—Of the remedies employed for the treatment of diseases of the heart, there are none more important than those means by which we can either diminish or increase the quantity of the heart's blood.

The curative effects of abstracting blood in diseases of the heart are two-fold; the one produced by changes in the circulating apparatus, from a diminution in the quantity of the fluid contents of the heart's cavities; and the other, by abstracting from the system a portion of the vital element in those affections of the heart, wherein some morbid alteration has taken place, or in the inflammatory diseases of its different tissues; in such cases the effects of bloodletting being the same as when it is employed in the treatment of inflammatory diseases of other organs. But the effect of abstracting blood when the cavities of the heart have become congested, has no analogy to the effects of that remedial means in any disease of any other organ; for there is no organ in which the blood is contained elsewhere than in the blood-vessels.

The blood in the heart may be diminished, either by abstracting it from the system, or it may be removed from the heart to some distant part of the body; both which processes, I have already pointed out, are resorted to by the animal economy for the cure of disease.

Bloodletting an imitation of nature.

Of the curative processes employed by nature there is certainly no one more remarkable, or more worthy of imitation in the treatment of the disorders of the heart, than spontaneous *hæmorrhages*,—such bleedings taking place either from the nasal, the bronchial, the cerebral, or the portal vessels; and many are the persons who at some remote period of life had lost repeated and perhaps large quantities of blood, and who can narrate the history of an affection of the chest, which had entirely vanished from the period of the hæmorrhage.

Its great utility.

Bloodletting may be considered one of the most valuable curative means in the treatment of diseases of the heart. The abstraction of blood is no less useful in mitigating the inflammatory affections of the heart's structure, as in subduing those diseases in other organs; and it is the only means which we possess of removing blood when a superabundant quantity is collected in the cavities of the heart, or when it is in a state of *congestion*.

It may, indeed, be said, that there is almost no malady to which the heart is liable, wherein bloodletting is not useful during at least some period of its progress.

Two different purposes effected by it.

In the treatment of disorders of the heart, blood may therefore be abstracted for either of two very different purposes: it may be employed to relieve a congestion of the cavities of the heart, or to subdue an inflammatory state of any of the heart's structures; and the difference of the *modus operandi* of bloodletting in these two cases, will point out the rules by which we ought to be guided in adopting it in each of them.

In inflammatory affections of the heart, bloodletting is a remedy as powerful as it is in the cure of inflammatory affections of other organs; and the general rules usually followed for adopting it are the same in both.

Wilson's Lectures on the Vascular System.

"In all the *phlegmasiæ*, where the pulse is the chief indication for the treatment, we in fact do nothing but mitigate the state of the heart."

The quantity of blood to be removed.

The *quantity* of blood which ought to be removed in disorders of the heart, is an essential point to determine in all cases where bloodletting is resorted to. As a general rule, I may remark, that whilst in inflammatory affections of the heart bloodletting should be employed to the same extent as in inflammatory affections of equal severity and accompanied by febrile symptoms of equal violence in other vital organs; yet, in all cases of *congestion*, bloodletting must be resorted to with great caution; for although in inflammatory affections nothing subdues the symptoms so effectually as even a protracted state of syncope from the loss of blood, yet a fainting state is to be particularly guarded against where there is merely a sanguineous congestion; for should syncope be produced under such circumstances, there is danger of the patient not recovering from it.

We are also to consider the comparative effects of *general* and of *local* bloodletting.

I have explained at considerable length in another work[*] the indications by which we should be guided in adopting one or other of these modes of bloodletting; laying it down as a general rule, that general is preferable to local bleeding in those diseases accompanied with fever; whereas, in disorders which are not accompanied by any febrile excitement, local bloodletting is preferable to general bloodletting.

This rule is not, however, so invariably applicable to the treatment of affections of the heart as to those of some other organs; from the circumstance, that the relations of the heart to the blood are very different from the relations of the vital fluid to the other organs of the body.

In all cases of inflammatory diseases of the heart accompanied by a febrile state of the system, general bleeding will be found preferable to local bleeding; but, on the other hand, in all cases of sanguineous congestion, whether in the cavities of the heart or coronary vessels, *leeches* ought to, in most instances, be preferred to phlebotomy; for, by adopting this mode of abstracting blood, we completely avoid all those dangers which may arise from general bloodletting being carried too far.

Advantages of leeches.

One great advantage of bleeding by leeches is derived from the circumstance, that the *quantity* of blood which they withdraw seems to depend, at least in a great degree, on the fulness or particular condition of the vessels of the part where they are applied; so that a certain number of leeches will withdraw much more blood if applied on the arm of an inflamed hand, than the same number applied on the arm of the sound hand of the same person. Hence, the propriety and safety of this mode of abstracting blood in disorders of the heart; the quantity evacuated by a given number of leeches not depending on any preconceived notion of what might be required for the relief of the disease.

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[*] "On Bloodletting; giving an account of its Curative effects, with rules for employing both Local and General Bloodletting in the treatment of Diseases." By James Wardrop, M.D., 1835.

Indeed, nothing shows more the preference which ought to be given to the use of leeches to other modes of bloodletting than the difference in the quantity of blood which is abstracted by them in a succession of bleedings on the same patient, each application yeilding less and less blood in proportion to the abatement of the symptoms and the diminution of the fulness of the vessels, and consequently pointing out in almost every case the propriety of pursuing or of discontinuing the depletive system.

Their application to the chest.

In disorders of the heart the leeches may be applied to any part of the parietes of the chest; but the *cardiac* region is generally to be preferred. The free inosculation of the external and internal mammary arteries, the vascular communication between the internal mammary, and the arteries of the pericardium, and the inosculations between these arteries and the coronary or nutrient arteries of the heart itself, sufficiently explain the decided benefit which is derived from this mode of abstracting blood in the disorders of the heart.

The number to be employed.

The *number* of leeches which ought to be applied to the parietes of the chest also deserves consideration; and it is a circumstance of importance to be aware, that the bleeding from their wounds is not in the ratio of the number which is applied, as is usually supposed: and so much the contrary is this the case, that I have been often surprised to find three or four leech-bites bleed much more in proportion to what double or treble their number would have done; and, from this circumstance, whatever explanation of it be offered, I have long been in the practice of using only three or four leeches; whereas, formerly, in similar cases, never less than two or three times that number would have been applied.

Applied to the feet.

Leeches may also be applied to the *feet* as well as to the chest in disorders of the heart; and however inexplicable this may be, I have had ample opportunities of testing the comparative utility of this mode of bloodletting in affections of the heart, being in the habit of recommending the leeches to be alternately applied to the chest and feet, and leaving the patient afterwards to repeat whichever mode afforded the greatest relief; and in many cases

Comparative effects from.

a decided preference has been given to their application to the feet.

Cupping is a mode of abstracting blood, the effects of which are, in some respects, similar to the application of leeches. When the cupping is employed upon the back of the neck or between the shoulders, it appears to me to be an eligible mode of abstracting blood in diseases of the heart ; because the vessels from which the blood is abstracted ramify with the intercostal and mammary arteries. Cupping does not, however, possess the advantage of leeches, which, as I have said, cause a flow of blood in proportion to the congestion of the vessels which they bite ; whereas, the quantity of blood to be extracted by cupping can only be regulated by the changes produced on the radial and cardiac pulses.

There is, too, an effect of cupping materially different from that produced by the application of leeches. The action of the cupping-glasses, as well as the pain they create, cause a large flow of blood to the parts upon which they are applied ; and, in employing cupping on other parts of the body, we often find that the flow of blood to the diseased part caused by the glasses, does more harm than the relief derived from the abstraction of the blood.

Difference in the effects of abstracting venous and arterial blood.

In another work* I have endeavoured to explain, at some length, the differences in the curative effects of abstracting *arterial* and *venous* blood,—a subject which had never claimed the notice of physiologists ; arteriotomy being recommended in preference to venesection, merely for the purpose of getting a larger quantity of blood withdrawn in a shorter time, especially in affections of the head. It is, however, quite evident that the effects of abstracting venous or arterial blood must be very different, whatever be the claim that each of them may have, as a curative measure.

The removal of the blood before the secretions and excretions have been separated from it, cannot have similar effects upon the system as the abstraction of a like quantity of blood after having parted with the essential elements of life.

The difference in the physiological phenomena resulting from arteriotomy and venesection are no less remarkable. The abstraction of *venous* blood causes little change in the condition of the adjacent venous system, the powers of dilatation which the veins possess at once receiving all the blood which would have passed by the wounded vessel. But when an artery has been wounded, to stop the bleeding it is necessary to divide it, and to place a ligature upon the bleeding orifice; and there takes place almost instantly a restorative process—a process to provide the parts which have been deprived of their arterial blood with a due supply from anastomosing branches; so that those structures which had become pale and bloodless whilst the arterial blood was making its escape, may, immediately after the operation, be observed to be as much distended and reddened as before it was performed.

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* "On Bloodletting," &c., &c. By James Wardrop, M.D., 1835.

The morbid changes in the blood imperfectly investigated.

When investigating the changes in the *qualities* of the blood from disease, the chemical philosopher has surely erred in not analysing the *arterial* as well as the *venous* blood, and comparing the changes in the two bloods.

Arterial blood in diseases not yet analyzed.

Those changes which take place in the arterial blood after it has passed through the various organs, and after the different secretions and excretions have been abstracted from it, must render any knowledge we possess of the diseased changes in the venous blood totally inapplicable to those of the arterial blood. An analysis of both bloods would, doubtless, be of great importance, and until chemical science reveals the changes which disease produces in the arterial blood, our knowledge of the morbid characters of that vital fluid must remain extremely limited and imperfect.

As a therapeutic agent, we know the curative effects of bloodletting only by abstracting a *quantity* of it from the system, or from a particular organ; but bloodletting is not resorted to as a remedial measure from any supposed changes in the *qualities* of the blood.

Blood, how to be diminished in the heart.

The blood in the heart may be *diminished* without removing any portion of it from the general system; and this can be accomplished by the common operation of *dry-cupping*, or by Junod's pneumatic apparatus applied to the extremities.

At the same time, friction, rubifacients, the pediluvium and the manuluvium, all produce their curative effects by diminishing the quantity of blood within the heart, and thus assist in restoring the due balance of the circulation.

Dry-cupping.

Dry-cupping has been employed since the days of Hippocrates "to recall the course of the blood which was going where it ought not to be;" and I have repeatedly seen the same beneficial effects result from dry-cupping as from local bleeding.

Case.

A young lady who had often successfully applied leeches to the cardiac region to relieve congestion, was led to try the effect of dry-cupping; and, in future attacks, she experienced, on many occasions, as much benefit from the dry-cuppings as from the bleedings.

Junod's cupping-boots.

To diminish the quantity of blood in the heart by increasing it in the extremities, an ingenious instrument was invented and satisfactorily applied by Junod; and although the principle of abstracting blood from one part to another, by the removal of the atmospheric pressure, had been employed as a remedial means, yet originality is justly due to Junod's instrument and its application to the treatment of disease.*

Gazette Medicale, No. 25.

His method consists in employing a pneumatic apparatus, in which an arm or a leg is so placed that the quantity of blood in the extremities can be increased to any degree, and, consequently, a corresponding diminution takes place in its quantity in the trunk of the body.

Blood, how to be increased in the heart.

The quantity of the heart's blood may be *increased* when it is required to increase the vigour of the circulation; and this may be accomplished not only by the administration of internal remedies, but also by mechanical means, such as by the compression of the arteries of the limbs, by the horizontal posture, by artificial respiration, and by muscular movements.

By ligatures on the extremities.

See page 104.

Ligatures placed upon one or more of the extremities have the effect of increasing the blood in the heart, by impeding its flow in the arteries; and I have formerly, at considerable length, endeavoured to show, that the vigour of the heart is restored, either by placing a tight ligature upon a limb, or by the pressure of muscles during their contractions.

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* The priority of the invention, the principle, has been fully discussed in the Lancet, Vol. II., 1837—38.

Utility of in cholera morbus.

This method of restoring the vigour of the heart is particularly adapted to relieve *syncope;* and has been successfully employed by Dr. Wise, in the treatment of *cholera morbus.* "When the patients are brought to the hospital, or when I see them first in a collapsed state of cholera, I give a pill, composed of assafœtida, opium, and capsicum; and I apply the tourniquet to the four extremities. This throws several pounds of blood into the trunk, and disturbs and removes the morbid action; and thus patients are cured when there is no chance with any other remedies."

Lancet, Vol. II., 1848.

And in syncope.

The compression of arteries must, however, be used in diseases of the heart with extreme caution. If fainting arises from a languor of the circulation, such as that which is occasioned by the loss of blood, the fainting state may then be relieved by arterial compression; but if syncope be caused by congestion from changes in the heart's structure diminishing its expulsive powers, then the evil will, in all probability, be increased by increasing the quantity of blood in the heart.

This leads me to repeat what has been said of the difference in the condition of the general system of a person in a state of *syncope,* and of another in a state of *apoplexy.* In syncope the whole of the powers of organic, as well as of animal life, are diminished according to the degree of the diminution in the vigour of the circulation; whereas, in apoplexy, it is the powers of animal life only which are more or less destroyed, those of organic life remaining unimpaired.

For the relief of fainting, we must therefore have recourse to those means which will invigorate the circulation, which explains the danger of bleeding in those who are in a state of syncope; but in apoplexy the congestive condition of the cerebro-spinal system requires the abstraction of more or less of the vital fluid.

Emetics and Nauseants.—Nausea and vomiting are two other processes resorted to by the economy to restore disturbances in the circulation, which can be artificially imitated, and which are employed as remedial measures in the treatment of the disorders of the heart.

Considered separately, the phenomena of nausea and vomiting, and the influence of each of these acts upon the system, are so

Magendie Chiarac, &c. perfectly different, that conflicting theories and conjectures have been made in order to explain their nature, and for what purposes they should be associated together in order to perform one act in the economy.

The observations which have been already made, and the explanations that I have offered of their phenomena, point out the influence of these processes when artificially employed for the treatment of diseases of the heart; and when we consider their curative effects, we find that they differ in each act, and that they may either be separately produced, or that beneficial effects may arise when both acts are combined. See page 229.

The influence of vomiting, with nausea, upon the circulation, is of importance to be kept in mind in the treatment of disease; and I have endeavoured to show that the vigour of the heart, and, consequently, the momentum of the blood's currents are diminished by nausea, and that vomiting, by its mechanical action upon the heart, co-operates in restoring the disordered circulation. See page 230.

That there is a great change on the action of the heart during a state of nausea, and an influence of a very opposite character during a fit of vomiting is quite evident; in proof of which we have only to observe the changes in the system during each of these conditions.

In *nausea* the countenance becomes pale, and there is a general sensation of cold, a feeble pulse, great prostration of strength, along with moral depression.

But when *vomiting* commences, the face becomes flushed, there is a sensation of general warmth, the pulse acquires additional vigour, and, after the fit of vomiting, a general perspiration follows.

Though some degree of nausea usually accompanies vomiting, I have said that nausea also takes place without vomiting, and is resorted to by the economy to relieve disturbances in the circulation; and, at the same time, it is one of those remedial means which we can imitate by medicinal substances.

In the treatment of disorders of the heart, it is generally expedient to employ vomiting with nausea; for in those cases where the affection of the heart is sympathetic of a disordered stomach, it is not only requisite to evacuate the contents of the stomach, but also to restore the balance of the circulation; and where the affection of the heart is primary, not only do we find relief from nausea, but the mechanical effects of vomiting also contribute to restore the disturbed circulation.

Vomiting is employed by the economy for the purpose of evacuating noxious ingesta, and in making that evacuation there is no effort made by the abdominal muscles, but the contents of the stomach are removed by its own contractile powers.* So far, vomiting may be considered a mechanical act; but when it is accompanied by more or less nausea, then, besides evacuating the stomach, the powerful action of the abdominal and thoracic muscles produce changes in the action of the heart.

There are many disturbances in the action of the heart arising from the presence of morbid secretions in the stomach, and wherein relief is obtainable by their evacuation.

Sometimes the effects of noxious food in disturbing the circulation are apparent soon after it has been received into the stomach, and these disturbances are immediately relieved by an emetic; and how frequently it happens, that the life of the suicide is spared by the dose of poison being so large as to cause instant vomiting!

Food of an improper quality sometimes remains in the stomach for a much longer period, I suspect, than is usually supposed, and often causes a disturbance of the heart.

Case. A young man eat some *onion*, and after six weeks of great suffering and derangement of the circulation, he vomited several pieces of onion, immediately after which he recovered.

Some emetic substances seem to act directly upon the stomach, and others are first absorbed into the blood, and thus influence the nervous system, or those portions of it from which those nerves emanate, and which supply the organs which cause both the nausea and the vomiting.

The simple distention of the stomach, produced by warm water, or the titillation of the fauces, is sufficient to cause vomiting; and an infusion of chamomile or mustard produce analogous effects; but when an emetic substance, such as ipecacuanha or tartrized antimony is received into the stomach, it is first absorbed and mixed with the blood; after which it produces nausea and vomiting, in like manner as the same substances do when injected into a vein.[*]

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* Hale estimated the strength of the stomach on the aliment to be about 20lbs.

In these respects, the influence of emetic substances on particular portions of the cerebro-spinal system is quite analogous to that of some other medicinal substances after their absorption and admixture with the blood, such as belladonna, strichnine, and chloroform, each acting only upon some particular portion of the nervous system. See page 171.

In contemplating, therefore, the effects of vomiting combined with nausea, we must consider their influence, both upon the stomach and upon the sanguineous system.

Remedial effects of emetics in disorders of the heart.

The remedial effects of emetics in disorders of the heart are far more extensive, and their use of much wider application than I believe to be usually practised.

They produce Diaphoresis.

In those cases where the functions of the skin have been interrupted from exposure to cold, or those of the lungs from breathing cold air, and thus causing a change in the balance of the circulation, the quantity of blood in the skin and in the extremities being diminished, there is a corresponding congestion within the great cavities, and especially in the heart. The violent convulsive movements in such cases produced by the action of an emetic cause the heart to be unloaded, and an additional quantity of blood to be sent to the cutaneous capillaries, by which their circulation is restored and heat and moisture are produced.

This effect of vomiting, with nausea, causing a change in the state of the cutaneous capillaries has long been remarked, but pathologists never seem to have duly considered that such a change in the capillary system was the effect of changes in the condition of the central organ, so that when inquiring into the curative effects of emetics, and the influence which they produce on the system, little or no reference has been made to these changes in the heart—changes on which the condition of the capillary circulation must entirely depend.

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[*] John Hunter produced vomiting by injecting ipecacuanha into a vein. "An infusion of *ipecacuanha* injected into the vein of a dog produced sickness directly, even before I could suppose it could have reached the heart; and a scruple of *jalap* in infusion produced sickness and purging."—*Lectures*, p. 33.

Curative effects of vomiting in disorders of the right heart.

Emetics have been found useful in many diseases depending upon the condition of the heart. In affections of the *right* heart we see remarkable benefit derived from emetics, and these effects are evident on the *cerebral*, on the *pulmonary*, and on the *portal* systems.

Cullen's Mat. Med.

In *venous* apoplexy the good effects of an emetic in equalising the circulation and in restoring the balance between the arterial and venous systems is well known; and on the *veno-pulmonary* system the effects of vomiting are equally remarkable. No less powerful is the influence of an emetic on the *portal* system. "I know no means," observes Cullen, "of expediting the circulation in the *liver* so powerful as that of vomiting."

Exhibition of emetics.

There are no emetics more generally applicable to the treatment of the diseases of the heart than ipecacuanha and emetic tartar.

A large dose of *ipecacuanha* operates quickly and empties the stomach, whereas, if two or three smaller doses be given at intervals of a quarter of an hour a much greater impression will be made; and, indeed, ulterior effects will be produced; and this accords with what has been mentioned regarding the difference in the effects of large and small doses of other medicines. By varying the dose of ipecacuhana we can produce and prolong nausea to any desirable degree; or we can also administer it in such doses as to cause vomiting. For these purposes, however, I have long been in the habit of combining the ipecacuanha with antimony, in the proportion of seven drachms of ipecacuanha to one drachm of antimonial wine.

Tartarite of antimony.

The effects of the *tartarite* of *antimony* as a nauseating emetic are in most respects similar to those of ipecacuanha, and its exhibition is particularly applicable to the treatment of disorders of the heart.

Consecutive effects of emetics, how to be relieved.

One or more hours after the operation of an emetic, a few grains of calomel put upon the tongue will be found to relieve a sensation of sickness, which is frequently occasioned by an inverted motion of the duodenum having caused some bile to be poured into the stomach; and there is an uneasy state of the body, which often comes on after the vomiting and sickness have ceased, and to relieve which Sydenham was in the habit of giving an opiate.[*]

The excrementitious processes.

Next to the mechanico-vital processes which are resorted to by the animal economy to restore disturbances in the functions of the heart, let us consider those *chemico-vital* processes which are performed by the digestive apparatus, and by which processes the *incrementitious* compounds are separated from the ingesta and conveyed to the blood, and those processes by which the *excrementitious* substances are rejected and discharged from the body.

"The manner in which nature acts consists, on one side, in attracting what is good and agreeable to each species, and in retaining, preparing, or changing it; and, on the other side, in rejecting whatever is superfluous or hurtful, after she has separated it from the good."

Hippocrates.

The excrementitious substances.

As the disorders of the heart are influenced by the condition of the different excrementitious processes, and as these processes are employed by the economy to relieve disturbances in the circulation, the *excretions* become an essential channel for employing remedies in the treatment of the heart's diseases; and these processes we have the means of imitating by *purgatives*, by *hepatics*, by *sudorifics*, by *expectorants*, by *diuretics*, &c., &c.

The same excretary function may be performed by different organs.

When the system is disordered by the imperfect mode in which any of the excrementitious processes are performed, the economy has recourse to one or more of those that are healthy to execute the functions of that organ which is deranged. The alimentary canal can execute the excretive office of the skin, the kidneys, the uretus, or the lungs; the skin can execute that of the alimentary canal; the kidneys that of the liver; and the gastro-pulmonary mucous surface that of the uterus.

In conducting the treatment of those diseases of the heart where these functions are interrupted, we should, therefore, endeavour either to assist or restore that which is diseased, employing the others in order to perform what either of them is incapable of executing.

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[*] It has been pointed out by Magendie and Pelletier, that a weak decoction of nut-galls neutralize the powers of *emetine*, and might be employed to stop violent vomiting from Ipecacuanha.

Influence of the processes of excretion and incretion on the heart.

There are, indeed, no diseases more under the influence of the digestive apparatus than those of the heart, for not only is the circulation greatly affected, both by derangements in the incrementitious, and in the excrementitious processes, but the sympathy which exists between the digestive and circulatory organs, causes any imperfection in the functions of the alimentary canal to have a powerful influence on the heart.

In the treatment of the heart's diseases we cannot, therefore, bestow too much consideration upon those various states of the digestive organs which cause disorders of the circulation, and likewise on the means of remedying such derangements of the digestive functions.

These processes, when disordered, how remedied.

The animal economy employs various means to relieve imperfections in the functions of the alimentary canal instinctively prompting us to partake of such aliments and drinks as will improve the digestive process. And we are also provided with medicinal bodies, by means of which each of these processes can be corrected; by some of them we can assist in the assimilation of the food, or they may be absorbed and mixed with the blood; and by others we can increase or diminish the excretions.

The remedies for the first may be appropriately classed amongst the stomachics, whilst the others are placed amongst the purgatives.

Purgatives.—Of the excrementitious processes, let us first consider that of purging, which is frequently employed as a curative process by the animal economy, and is one which we have ample means of imitating by therapeutic agents.

Different uses of each.

In the use of purgatives for the treatment of disorders of the heart, it is of great practical importance to consider whether it be necessary to purge, or merely to *evacuate* the bowels; two processes, essentially differing in some respects from one another, though each effect may be produced by different doses of many medicines.

In the healthy state of the body, the alvine evacuations consist merely of the excrementitious parts of the aliment, or of those portions which are not absorbed and conveyed to the blood.

But, in many diseases, the mucous system of the digestive canal secretes from the blood fluids which are hurtful to the body, or the liver discharges vitiated bile, and thus a purging may be produced: one of those processes which nature employs for the cure of diseases, and which was considered by the older physicians as indicating a crisis; hence the danger of checking a *critical* purging.

These two conditions of the alimentary canal, evacuation and purging, satisfactorily explain the differences in the effects of cathartic medicines; and also the causes that have led them to be divided by Cullen and others into mild and drastic, laxative and purgative, aperient and cathartic; for the same medicine may either have a purgative or a simple evacuating effect, according to the quantity or the circumstances in which it is administered.

The particular effects of different purgatives.

Purgatives act upon different *portions* of the digestive canal, some upon the stomach, some upon the duodenum, some upon the small, and some upon the large intestines, and others upon the rectum; so that in the administration of this class of medicines it is essential to discriminate the portion of the canal which requires evacuation; and the more so, as that medicine which acts upon one of these portions has no effect upon the others.

They act upon particular portions of the alimentary canal.

Thus saline medicines act upon the mucous membrane of the stomach and small intestines, mercurials upon the salivary and hepatic secretions, and aloes upon the colon and the rectum.

Daily experience teaches us that purgatives may often be employed to a great extent, and continued for a lengthened period without much benefit, until finally some feculent matter is evacuated, immediately after which all the symptoms are alleviated.

Illustrated by analogy.

This action of medicines upon particular parts of the alimentary canal is perfectly analogous to what is observed of other medicinal bodies, which act only upon particular portions of other systems, and which is so remarkable in *neurotics;* medicines properly belonging to that class affecting only particular portions of the cerebro-spinal and ganglionic systems.

It is a curious and no less interesting law with regard to the effects of medicinal substances, that on whatever organ their medicinal powers act, it matters not how or by what channel the medicine enters the system. This is the case with purgatives, many of which act upon the alimentary canal, whether absorbed by the skin, inhaled by the lungs, or applied to the tongue.

Co-operation in the functions of the organs of excretion.

As the different organs of excretion, the skin, the alimentary canal, the lungs, the kidneys, the liver, and the uterus, all co-operate with each other in discharging from the body those matters which are superfluous or hurtful, in estimating the condition of any one of these organs, we must take into consideration the state of all of them; for, as in health, so we find their functions constantly varying in disease. Thus, the excretions from the intestines are diminished, when either the perspiration or the discharge of urine is increased; and, on the contrary, when perspiration or the flow of urine is diminished, the alvine discharge is increased.

Case.

Further, to show the extarodinary interchange which sometimes occurs in the excretions, and to what an extent constipation may happen without the bowels being overloaded with excrementitious matter, I may mention the case of a lady who for six weeks before her death had no evacuation, and on inspecting the body I found that the obstruction had been occasioned by the long neck of a tumour of the uterus, somewhat resembling a portion of umbilical cord, which had entangled and strangulated the intestine; and that instead of a congestion in the alimentary canal there was but a very small quantity of a dark yellow inodorous matter contained in the intestines.

Good's study of Medicine.

"A girl, fourteen years of age, in whom the anus and the *meatus urinarius* were imperforated, discharged regularly the urine by the nipple, and the fæces by vomiting."

Practical inferences.

This interchange in the functions of the organs of excretion is not only an interesting physiological fact, but there may be drawn from it an important principle for the treatment of the diseases of the heart, pointing out the necessity of regulating these excrementitious processes by administering such medicinal bodies as will restore the functions of whichever of these organs is disordered, and also of increasing the excretions of the others as the economy may seem to require.

Irregularities in the alvine evacuation.

An accumulation in the large intestines does not, however, in all cases, take place from irregularities in their evacuation, for although most persons in health have an alvine discharge every twenty-four hours, yet there is often irregularity in this, as in all in the generality of those who are suffering from a primary affection of the heart, I have not only found the functions of the alimentary canal unimpaired, but in many such cases the effect of a strong purgative is hurtful, especially when mercurials are combined with the purgative, and fails not to irritate and increase the action of the heart, and bring on a number of most distressing nervous sensations. These pernicious effects of purgatives may be frequently observed, in the too indiscriminate practice of giving a dose of calomel at night and a brisk purgative on the following morning.

On the other hand, when purgatives are required, as in those cases of irritability of the heart caused by the retention of feculent matter in the large intestines, its evacuation is essential, and is to be effected by those medicines which have a specific action on the large intestines, such as aloes, and castor or croton oil. A most decided evacuating effect will be produced by *croton* oil. The sixth, or even the twelfth part of a drop, combined with a few grains of colocynth, or with a teaspoonful of castor oil, is the dose I have usually employed; and this may be repeated every few hours as may be necessary. The application of this oil to the tongue, and its speedy action, affords a strong proof of the greater efficacy of medicinal substances when put upon the tongue, than when administered through other channels. See page 309.

Case. A young lady had been for some weeks much out of health, and, besides having headache, restlessness, and mental irritability, the action of the heart was so greatly disturbed as to create anxiety about its condition; the bowels were very irregular, and she had no appetite; to relieve which she had used a variety of remedies. Observing the root of the tongue to be much furred, I gave her a pill containing the sixth part of a drop of *croton* oil with colocynth; and, after taking two doses, she had several very copious fetid evacuations, after which the heart and all the other symptoms were relieved.

"You ought to take care how you evacuate or fill up at once, or too quick, or too much; and that it is equally dangerous to heat and cool again on a sudden; or rather you ought not to do it, everything that runs to an excess being an enemy to nature." Hippocrates.

Hepatics.—Whether the *liver* be considered an organ of secretion or of excretion, there is no doubt of the influence of any derangement of its functions upon the heart; and whether the *bile* is not duly secreted from the blood, or whether, after it has been separated from it, and again absorbed and mixed with the vital fluid,—when any of these changes take place, the vigour of the heart's action is then diminished, so that there is a corresponding loss of power in the muscular system, and in the energy of the intellectual powers. And whatever be the chemico-vital changes which take place in the blood during its passage through the liver, it is quite certain that there is excreted from it a liquid which, when mixed with the ingesta, as they pass through the duodenum, materially assists in chylification; and by a want of which, or by a change in its qualities, there is more or less disturbance in the digestive process. Derangement in the functions of the liver have always been considered as frequent causes of disease, and to those suffering from such ailments has been assigned the *bilious* temperament.

The vascular connexion between the heart and the *portal* system renders the treatment of derangements in the biliary functions intimately associated with those of the heart; for, as has already been observed, there is, in the diseases of the heart, an assemblage of symptoms caused by disturbances in the portal circulation; and to subdue these becomes an important curative indication.

See page 218.

Other disturbances in the heart arise either from the bile not being discharged into the duodenum, from its being absorbed into the blood after having been secreted, or from morbid changes in the qualities of that fluid.

When the biliary secretions are interrupted, other excretive organs, as the skin, the lungs, and the kidneys, will then be observed to perform that function of the liver; but, when these separate processes of the economy are inadequate to separate from the blood that which the liver was incapable to excrete, the necessary assistance may then be afforded by the agency of those medicinal substances which act specially upon the chylopoetic viscera, or by those which increase the other excrementitious processes, more particularly that of the skin and the kidneys.

Mercury may, for these purposes, be combined with antimony, Effects of mercury combined with other medicines.

opium, hyosciamus, conium, digitalis, or other narcotics, by all which the effects of the *mercury* are variously modified.

In many cases opium, combined with calomel has a most beneficial effect on the biliary organs, and can be freely used in persons on whom either of these medicines taken singly does not agree. In fact, we produce entirely new effects by combining calomel with narcotics.

No less valuable are the effects of combining mercurial preparations with those of antimony; calomel and the tartarized antimony, or James's powder, combined, not only changing the biliary secretions, but increasing the excretions of the cutaneous and of the gastro-pulmonary mucous membrane.*

Particular hepatic medicines.

Besides mercurial and antimonial preparations, rhubarb, the mineral acids, ipecacuanha, and the alkalis, are all medicines which, given singly or combined, experience has shown have a decided action upon the liver.

The use of mercurials.

The specific effects which mercury produces on the circulation are of great value in the treatment of many diseases, but these effects are equally injurious in certain conditions of the heart.

See page 143.

Edinb Med. and Surg. Journal, vol. xiv.

In relieving imflammatory affections of the different organs, mercury has a most decided influence, but it has already been mentioned, when speaking of the causes of the disorders of the heart, that mercury was one of those substances which not unfrequently produced disturbances in the circulation, and some cases are on record where it became the source of fatal disease. The influence of mercury upon the circulation, when exhibited in disorders of the heart, should be carefully watched, and the mode of administering it for restoring the functions of the liver, when such derangement is accompained with a disturbance in the functions of the heart requires much nicety; the difficulty in many cases being to relieve the liver without injuring the heart.

To fulfil this purpose, much depends both upon the quantity of each dose, the frequency of its repetition, and the mode in which it is combined with other medicines.

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* The combination of calomel with the sulphuret of antimony was first introduced into notice by Dr. Plummer, since which time it has preserved a high reputation. See the Edinburgh Medical Essays and Observations, 1733.

As to quantity, I have already remarked how fallacious it was to estimate the effect of a medicine by the quantity of it which is given, and pretend to be able to calculate that the effects will be increased or diminished according to the increase or diminution of the quantity.

Mercury may be administered in the diseases of the heart, as in the diseases of other organs, in a variety of forms—calomel, blue pill, or the mercury with chalk; and it may be either taken internally or absorbed by the skin, according to the particular circumstances of each case.

A large dose of calomel will generally act as a sedative, whilst a very small quantity will purge the bowels. At other times the large dose of calomel will empty the gall-bladder of a quantity of vitiated bile, when the small dose will be absorbed, mixed with the blood, and affect the organs of circulation, rendering the heart irritable, and creating what is usually called "mercurial fever." Indeed, *large* doses of calomel may be often safely administered to those who have found great disturbance of the nervous system from a *small* dose; and hence it is, that in all inflammatory affections where it is desirable that the system should be affected with mercury, *ptyalism* is more quickly produced by small doses frequently repeated, than by an equal quantity given in large doses. And it is also worthy of notice, that when mercury is given to relieve inflammation, and in a person who under other circumstances had suffered great uneasiness from even a small quantity of it, he can now reap essential benefit from its effects in relieving the inflammation; and it usually happens that when, in such cases, the inflammatory symptoms are subdued, the mercury, if continued, creates poisonous effects upon the heart. In conclusion, when, from whatever cause, the mercurial or antimonial preparations have either not been sufficient to subdue the derangement of the hepatic system, or that it has been advisable not to administer them, it will then be expedient to employ the mineral *acids*, either taking them internally or applying them to the skin; or *rhubarb* in small doses may be given, combined with *soda*, castile soap, or *ipecacuanha*.

Dermatics.—There is none of the excrementitious processes

Utility of sweating.

more frequently employed by the animal economy for the relief of disease than *sweating*, and its curative effects are no less valuable in various affections of the heart.

Hippocrates.

"All diseases are determined or cured by evacuations by the mouth, by stool, by urine, or some other such way; but *sweating is common to all, it takes off all alike.*"

Relation between the heart and the cutaneous capillaries.

The reciprocal influence of the cutaneous capillaries and the organs of circulation in health, and the state of the skin produced by changes in its capillary circulation, is one of the most useful tests that we possess of the condition of the heart, and points out an important channel for the employment of remedies; for whether the surface of the skin be hot or cold, dry or moist, these conditions all indicate particular states of the heart's functions.

and the cutaneous absorbents and nerves.

At the same time, there are two other important channels by which the heart and the skin are related,—the cutaneous absorbents and nerves, to both of which, as well as to the exhalents, a class of medicines belong, and through which channels they act upon the heart.

The interchange in the functions of excretion.

The circumstance, that all the different functions of excretion not only co-operate with one another, but the interesting fact, to which I have formerly alluded, that when any of these functions is interrupted, the excrementitious process can be duly performed by one or more of the others, points out how it is that, when either of them is interrupted, nature employs another to supply its place.

Is remarkable in the lungs.

This interchange, or reciprocity of functions, is forcibly illustrated in the skin; for whenever the lungs are diseased, or even when there is a temporary interruption to their exhalation, the respiration of the skin is increased, the skin discharging that carbonic acid which the lungs are unable to exhale.

Pathological illustrations.

In those suffering from pulmonary *phthisis* the exhalation of carbonic acid from the lungs being diminished, there is a proportionable increase in the exhalation from the skin, and hence we can explain the relief which they obtain from sweating; and when there is more or less pulmonary congestion from inflammation or *bronchitis*, the relief of perspiration is produced by the skin fulfilling the office of the lungs, and thus performing that office which the lungs had not been able to accomplish.

How often it happens, that by dancing or taking violent exercise on horseback, the sweating which ensues cures a catarrh? It may be truly said, that whenever any portion of the lungs cannot respire, the skin then respires for it.

If the evacuations from the alimentary canal are interrupted, the skin contributes, with the other organs of excretion, to separate and discharge from the blood those excrementitious compounds which usually are evacuated from the bowels; and whenever the excretions of the liver or kidneys are interrupted their functions too are assisted by the skin.

Difference in the functions of different portions of the cutaneous surface.

There is every reason to believe, from observations made in examining the *skin*, that the quantity of perspiration varies in different parts of the cutaneous surface. From Cruickshank's experiments, the average quantity exhaled by the hands was in the ratio of double the quantity exhaled by the whole body; and when we want to ascertain the condition of the skin, our attention is always first directed to the *palm* of the hand, as in it we perceive the most sensible deviations from the natural state. Sometimes it is hot, and sometimes cold; sometimes it is covered with a warm perspiration, and sometimes with a cold moisture.

These perform different functions.

That different portions of skin perform different functions accords with what is observed of other systems of the economy. There are peculiarities in the structure of different parts of the skin, in order to serve different purposes; such as differences in the vascularity, in the quantity of nerves and absorbents, and in the epidermis; all which differences may likewise be observed in diseases, particular eruptions chiefly affecting particular portions of the cutaneous surface.

Sudorifics, when to be employed.

The affections of the heart, in which artificial or augmented perspiration is particularly useful, are numerous.

It is employed in those affections where the disorder of the heart has been occasioned by derangements of the capillary system, in all which the restoration of the capillary circulation never fails to relieve the heart; and in the inflammatory affections of the heart it is equally beneficial to increase the excrementitious discharge by the skin.

In affections of the heart arising from changes in the qualities of the blood, especially those where its excrementitious materials have not been duly discharged from the system, more or less relief is obtained by augmenting perspiration. Of this we have an example in jaundice, where sweating, as well as increasing the action of the other organs of excretion, is a valuable remedy.

Its effects in gout.

The effects of sweating in warding off *gout* are very remarkable, that excretion, discharging from the system those vitiated secretions of the digestive organs which, when they are mixed with the blood, create a gouty paroxysm, and which by no means unfrequently attacks the heart, producing more or less arthritic inflammation of its internal membrane. In this manner, and upon this principle, there are many persons of an arthritic diathesis who, by daily taking sufficient exercise to cause a copious perspiration, are enabled to ward off an attack of gout.

Case communicated by Mr. Paxon.

A young man who had frequently suffered from gout, and to which disease he had a hereditary disposition, was in the habit, whenever he was threatened with an attack, to clothe himself very warmly and walk briskly, so as to induce a copious perspiration, by which he warded off the paroxysm.

In violent exercise.

The influence of sweating upon the circulation is well exemplified in the relief that it affords when it has been produced by violent exercise. On making any muscular exertion, the first effect of it is to cause the lungs to be more or less congested, and, consequently, to diminish the exhalation of the usual quantity of carbonic acid. But, whenever a copious perspiration ensues, the excretion of carbonic acid which it produces relieves the lungs, and there follows that immediate vigour in breathing and sense of exhilaration with which we are all so familiar.

The different sudorifics.

The means we possess to increase perspiration, or to produce sweating, appear to act primarily upon the heart, by which changes in the functions of the cutaneous capillaries take place.

The mechanical action of *vomiting*, and the influence of nausea upon the functions of the heart have a powerful effect on the cutaneous capillaries, producing perspiration more or less profuse, and thus constituting one of the most influential means which we possess for imitating that which the economy resorts to for causing perspiration for the cure of disease.

Of the medicinal substances usually employed to produce sweating, there is none more efficacious than the *tartarized antimony* or *James's powder*, given in small doses, either singly or in combination with a purgative. *Opium*, combined with antimonial or mercurial preparations, the compound powder of ipecacuanha or *Dover's powder*, the *acetate of ammonia*, and the *citrate of potass*, or of *soda*, are all useful *sudorifics*. And in employing these medicines we have another example of that analogy in the effects of medicinal substances to the curative processes which are employed by the animal œconomy. For in like manner as one organ of excretion can perform the functions of another, so medicinal substances either act upon one or other of the excreting organs. Tartar emetic acts either on the skin, on the pulmonary mucous membrane, or on that of the alimentary canal, causing either sweating, expectoration, or purging; and it is the same with calomel, that preparation either increasing the mucous secretion of the intestines, evacuating the gall-bladder, increasing the biliary excretion, or producing perspiration.

Effects of warm and cold drinks.

Warm and cold drinks, and warm and cold substances applied to the cutaneous surface, have each a powerful influence in causing perspiration.

Warm drinks are commonly resorted to either to restore the natural warmth of the skin, or to cause sweating; and cold drinks are equally efficacious in producing both these effects upon the cutaneous capillaries.

See page 132.

I have, on a former occasion, pointed out the great influence which both very hot and very cold substances, taken into the stomach, have upon the heart, and made allusion to some instances where they proved fatal; and it appears to me, that the changes produced in the action of the cutaneous capillaries, either by warm or cold drinks, arise from the effects which these produce upon the action of the heart. In order to cause a copious perspiration, such as persons have recourse to who are in "training," it is usual after a long walk to lie down in a bed between blankets in a warm room, and drink a quart of *cold* water, a short time after which a profuse perspiration ensues.

This effect of cold drinks accounts for the thirst and the strong desire which the sick have for cold drinks in febrile diseases, and in those stages where the skin is parched; and the propriety of allowing them to gratify this instinct of the œconomy. An officer, in India, who was suffering from fever, over-heard his medical attendants, when they were consulting together in an adjoining apartment, hold out no chance of his recovery. In this hopeless condition, he determined to gratify a strong desire he had to drink *sangaree*, which is composed of vegetable acids and spirituous and fermented liquors greatly diluted, and after drinking a very large quantity of it, a profuse perspiration immediately ensued, after which all the symptoms of the disease were immediately subdued, and he rapidly recovered.

Case.

Effects of warm and cold bathing.

The cutaneous surface is equally influenced by the local application of warm and cold substances, as it is by these when they are taken into the stomach.

The influence of the *warm bath* in promoting perspiration is universally acknowledged, and the *pediluvium* and the *manuluvium* are also employed for the same purpose. There are some persons in whom the warm bath has a very opposite effect on the capillary circulation, the skin, in place of being moist, becoming hot and dry, accompanied with headache and quickened circulation; and in such cases there will often be found some disorder of the heart. In like manner, there are some persons in whom the *pediluvium*, in place of restoring the balance of the circulation, produces an injurious effect, and in these instances there has generally been a permanent disorder of the heart. A lady suffered great distress in breathing whenever she put her feet into warm water; and a maid-servant became faint on several occasions when she made use of the *pediluvium*.

Cases.

The *pediluvium* may consist either of water, of a blood heat, or it may be used as hot as the patient can endure it for a very limited time. In the first case, the feet and legs should be immersed from a quarter to half-an-hour, taking care to add warm water in sufficient quantity for the bath to sustain the proper temperature during the whole time of the feet's immersion.

Besides the effects of the heat and moisture, stimulants may be added to the water, such as mustard, vinegar, or common salt, these increasing the influence of the bath, or, if friction be desirable, the limbs may at the same time be rubbed with meal or bran.

The application of *cold* to the cutaneous surface produces a powerful influence on the capillary circulation. Hence the use of the *cold* bath, the *shower* bath, the cold *affusion*, and the *evaporating* lotions, all which require discrimination in their use, and particular attention to the condition of the heart, as there are many instances of evil effects having arisen from employing them when the heart has been diseased.

The formation of eruptions and pustules.

Pustulation, vesication, and rubefacients. Besides sweating, the skin performs excrementitious processes by the formation of *eruptions* and *pustules*, these discharging from the blood serous and puriform fluids, and, like the other excretions which we have been considering, they are also employed by the œconomy for the cure of disease.

Their curative effects.

The importance of these excrementitious processes we can measure only by the effects which are produced upon the system when they have been interrupted by external agents, such as by changes in the temperature of the atmosphere, or by the application of such substances as arrest their progress; and on no organs are these injurious effects more remarkable than in the organs of circulation; for as we have found with regard to the other excretions, that if the noxious matters which they are destined to expel from the body are not removed by the respective organs, the blood becomes vitiated, and the action of the heart more or less disordered.

Injurious effects of checking them.

In the exanthematous diseases, the hurtful effects of checking, by any means, the progress of the eruption, or of altogether preventing its appearance, are well known, and always lead to an increase in the action of the heart, and of all the febrile symptoms, which can only be allayed by restoring the eruption, or by increasing the other excrementitious processes.

But, in chronic eruptions, the effects of arresting their excretions by any external applications is still more pernicious, and it is by no means uncommon to meet with instances where persons with an eruptive disease of long standing, and limited even to a very small portion of the cutaneous surface, and who, from making use of some application by which the eruption had been checked, have suffered from various ailments arising from disturbances of the circulation, all which are quickly removed whenever the eruption re-appears, or when depletive means are judiciously adopted.

How they can be imitated.

In imitation of these processes of the œconomy we can produce *pustulation* and *vesication*; the formation of artificial pustules separating from the blood a puriform fluid, and vesication withdrawing from it a serous exudation.

In those disorders of the heart which are connected with changes in the qualities of the blood, especially those accompanying exanthematous diseases, and inflammatory diseases of an arthritic or rheumatic character, pustulation and vesication are valuable remedies; and rubefacients, which may be considered as a milder degree of vesication, are no less useful. These remedies and blisters have the advantage of acting quickly, and are therefore more applicable to the more acute forms of disease, whilst pustulation is generally made use of in chronic affections.

The kidneys excrete urine only.

Diuretics.—It has already been remarked, that the kidneys are unlike any of the other excrementitious organs, performing no other function but the excretion of urine, nor does their function seem to be so intimately associated with those of the sanguineous system as those of the other excrementitious organs, although the effects of general excitements and of the hysteric paroxysm in causing a more or less sudden increase in the flow of urine, sufficiently points out their relation and their reciprocal connexion both in health and in disease. The influence of the passions on the circulation seems to produce effects upon the kidneys precisely analogous to those which we so frequently observe on the skin, by causing sudden perspiration, and upon the mucous membrane of the alimentary canal by diarrhœa, effects which, in disturbances of the heart must, however inexplicable, be intended to fulfil some essential purpose in the animal œconomy.

Their consent with the heart.

Influence of the passions on the urinary excretions.

Interchange in the function of the kidneys.

The same interchange takes place between the kidneys and the other organs of excretion as it has been observed which these have with one another,—the skin, the lungs, and the alimentary canal, each in their turn performing the function of the kidneys.

Diuretics.

In like manner, as we possess the means of increasing the quantity and of altering the qualities of the excretions from the skin, and from the alimentary canal, so we have medicinal substances, by the administration of which we can increase the quantity and change the qualities of the urine.

Their modes of action.

Some of these diuretic medicines are absorbed and pass unchanged with the blood to the kidneys, such as potass, turpentine, and cantharides, whilst there are others which undergo chemical changes, such as the acetate and supertartrate of potass, before they reach the kidneys. And, as has been remarked of the other organs of excretion, in which alone some medicines act, so it is as regards the kidneys, diuretics producing their particular effects through whatever channel they may have been introduced into the system,—whether they be received into the stomach or inhaled by the lungs.

The quantity of the urine may be changed by them.

There are some medicines by which the *quantity*, and others by which changes in the qualities of the urine may be produced.

Water and diluent drinks increase the urinary secretion by passing rapidly to the kidneys, and the exposure of the skin to a cold temperature by diminishing the cutaneous exhalation also causes an increase of urine. And there are medicinal substances which, by promoting the absorption of the fluids effused into the serous cavities, convey them to the blood, from whence they are excreted by the kidneys. *Mercury*, *digitalis*, and *squills*, have this effect in a remarkable degree, and these medicines are of great value when used singly or combined with one another.

In those disorders of the heart where any of the excretions are imperfectly performed, diuretics are a useful remedy, and their exhibition is pointed out especially in those maladies where there is any effusion within the pericardium, which effusions, we know, are not only relieved, but frequently warded off by the judicious use of diuretics. Indeed, the employment of this class of medicines in diseases of the chest has been deemed very important since an early period of medical history.

The *qualities* of the urine are variously altered by derange-

and likewise the qualities of the urine.

ments in the digestive process, and these often cause disturbances in the circulation, so that by improving the digestive function we can change the nature of the urine, and thus restore the disorder of the heart. *Alkalis, iodine,* and the mineral *acids* are especially useful in the treatment of the diseases of the heart of an arthritic and of a rheumatic character, in all which the digestive function is usually more or less deranged.

The excrementitious functions of the lungs.

Pneumonics.—The intimate relation which subsists between the heart and the lungs, and their reciprocal influence both in health and in disease, lead us to inquire how the respiratory organs are employed by the animal œconomy to perform or to assist in performing an *excrementitious* process.

Now we find that the mucous membrane which lines the bronchi, like the external skin, performs one of these excrementitious functions, and this pulmonary excretion becomes variously modified in diseases of the heart, copious mucous discharges taking place, and which processes are employed by the animal œconomy to mitigate disease.

"There is a constant and considerable exhalation of moisture from the cavity of the lungs; and there are many reasons for believing, that this is an *excrementitious* secretion, connected with the other excrementitious secretions, particularly with the perspiration from the surface of the body."

Cullen's Mat. Med.

Artificial coughing first introduced by the Cnidian physicians.

Even before the time of Hippocrates, physicians talked of "purging" the lungs, using that term in the same sense as it has since been employed to signify the purging of the alimentary canal; and of such importance did they consider it requisite for the cure of diseases of the chest, that they artificially produced "*coughing* in order to evacuate the excrementitious secretions from the bronchi."

The lungs, how purged.

To purge the lungs, the patient was ordered "to draw in his tongue as much as he was able, and when that was done the physician endeavoured to put into the hollow of the lungs a liquor that irritated the part, which, raising a violent cough, forced the lungs to discharge the purulent matter which was contained in them."

See Le Clerc's history of Physic.

It may be observed, that the act of vomiting, besides evacuating the stomach, has, likewise, a mechanical effect upon the lungs, evacuating from the bronchi those accumulations of mucus for which coughing alone is not always sufficient; and in such cases where there is also collected a large quantity of the mucus of the stomach, vomiting is frequently accompanied with violent coughing; so that by the two acts—vomiting and coughing, a morbid collection of mucus both in the stomach and in the lungs may be freely evacuated.

There is indeed a strict analogy in the acts of vomiting, coughing, sneezing, weeping, and purging, each being a muscular action employed by the œconomy to remove an excretion, either from the stomach, the air-tubes, from the nasal or lachrymal passages, or from the alimentary canal.

Gases exhaled by the lungs.

But the lungs perform another and a most important excrementitious function by the *gases* which they exhale, the quantity of the pulmonary exhalation being no less remarkable than that which takes place from the cutaneous surface.

See page 342.

Colliquitive sweats.

As I have already observed, this excrementitious function of the lungs may be also executed by the skin, and the interchange of functions between the lungs and the skin is exemplified in those cases of disease wherein a large portion of the lungs is destroyed and unable to exhale the requisite quantity of carbonic acid, and in which its exhalation is performed by the skin. And when neither the lungs nor the skin can longer execute this function sufficiently, it is then that the lungs become so filled with carbonic acid, that from its deleterious effects upon the system, the vital powers sink, and thus life is gradually, and as it were insensibly extinguished!

Expectorants.

Ansell's Lectures on the Blood.

In those disturbances of the heart which are either caused or aggravated by that condition of the pulmonary mucous membrane which is relieved by expectoration, there is no medicine so useful an *expectorant* as the *tartarized antimony*. When given in sufficient quantity to cause vomiting, the mechanical effects of this act have often a powerful influence in evacuating whatever morbid mucus may have been collected in the bronchi; but when given in doses sufficiently small to be absorbed into the blood, it then has a decided influence on the pulmonary circulation, so that while the mucous secretion is facilitated, there is also produced a corresponding diminution in the inflammatory symptoms.

There is, indeed, the same specific effect produced upon the pulmonary mucous membrane by the administration of the tartarized antimony, as by that medicine on the mucous lining of the alimentary canal.

Besides antimonial preparations, there are other medicinal substances which act upon the pulmonary mucous membrane, such as *ipecacuanha* combined with *opium, squills*, the *balsams, ammonia*, and *ether;* all of which may with propriety be employed to relieve different morbid conditions of the mucous membrane of the lungs accompanying disorders of the heart.

These substances may either be inhaled or they may be taken into the stomach, or absorbed by the skin, and conveyed by the blood to the respiratory organs.

The experiments of Orfila.

Thus we perceive that there are many substances which, when taken into the stomach or absorbed by the skin, such as ether, camphor, and garlic, the pulmonary exhalation contracts their odour. And the experiments of Orfila have shown that the molecules of substances which have passed through the intestinal canal abound in the pulmonary exhalation, a ligature placed upon the œsophagus proving that such exhalation could not have come from the stomach. Turpentine injected into the crural vein was also exhaled by the lungs.

and of Brechet and Edwards.

Menstruation.

Genetics.—The periodical sanguineous exhalation from the uterus, is another excrementitious process, and any irregularity in the accession of the period, or any change in the quality of the discharge, is a frequent cause of a disturbed heart. Indeed, there is no excretion the healthy condition of which has greater influence on the heart than *menstruation;* for we invariably find that every derangement of that function is either preceded by or causes more or less disturbance of the circulation; and this relation between the heart and the uterus will satisfactorily explain the curative effects of *emmenagogues* in those diseases of the heart which are accompanied by a disordered uterus.

Its influence on the functions of the heart.

Such, too, is the intimate relation between the uterine and the circulating organs, that the various interruptions and changes to which the menstrual flux is liable exercise a powerful influence on the sanguineous system; and therefore, in the treatment of diseases of the heart accompanied with uterine derangement, it is of essential importance to employ such means as will restore the balance of the circulation when the menstrual excretion has been interrupted, or improve the qualities of that excretion when these have been changed. Hence the use of *emmenagogues* in many of the disorders of the heart, a class of medicinal bodies, some of which appear to act directly upon the uterine system, and others through the medium of some of the other systems of the œconomy.

Peculiar character of the uterine excretion.

The menstrual flux, it may be here remarked, materially differs in many respects from all other excretions. It commences only at a particular time of life, it recurs periodically, and at another age it ceases altogether. It consists, not of the separation of any excrementitious matter, properly so called, but of a sanguineous discharge from the mucous membrane of the uterus, by which process a superabundant quantity of the vital fluid is abstracted from the body; the system being provided with an extra quantity of blood only during that part of a woman's life when impregnation may take place, and when such extra quantity of the vital fluid may be required for the nourishment and growth of a fœtus.*

Menstruation co-operates with other excretions.

Andrall and Gavarret.

This excretion appears also to co-operate with the lungs and the skin in removing carbon from the system, and the respiratory and uterine systems are so intimately associated, that, during the menstrual flux, it has been ascertained that much less carbon is exhaled by the lungs; but after the cessation of the menses, there is a considerable increase of carbon in the pulmonary exhalation. Accordingly, there is a remarkable change in the odour of the breath in a woman during menstruation, arising probably from the uterus assisting the lungs during that period in discharging carbonic acid. And, too, like the other excretions, menstruation may also be performed by other systems when the uterus is incapable of executing it. It may be performed by the different portions of the gastro-pulmonary mucous membrane, by ulcers, and by diseased growths.

Use of Emmenagogues.

The condition of the heart varies exceedingly, according as there is a complete interruption to the flux, whether it is irregular, whether its quantity is diminished, or whether there is a change in the qualities of the exhaled fluid; and our curative means enable us not only to restore the menstrual excretion, but also to relieve the system from the evil effects of its suppression. When the menstrual flux is interrupted, as often happens from the feet having been exposed to cold, or from any violent emotion, we can imitate the excretion and relieve the system, by artificially abstracting the surplus blood which should have been evacuated by the flux. In this, as in a plethoric state of other organs, *bloodletting* and other depletive measures are indicated; for the abstraction of blood will at all times mitigate the symptoms arising from any congestion in the heart, and improve the general health. But, to insure the return of the flux, the active means should be employed immediately before the usual period of its accession, and the best calculated to effect this purpose, besides bloodletting, are those which act upon the uterine system. *Emetics, purgatives,* and the *pediluvium,* powerfully assist in restoring a suppressed menstruation; and, indeed, there is no emmenagogue more to be relied upon than an *emetic.*

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* Brande found that the menstrual flux resembles in its component parts a very concentrated solution of colouring matter in a diluted serum.

In those disturbances of the heart, accompanied by changes in the *qualities* of, and by irregularities in the uterine excretion, the condition both of the uterus and heart can only be relieved by the use of those medicines which change and improve the qualities of the blood, such as the various preparations of iron and of copper.

CHAPTER XIX.

GENERAL OBSERVATIONS ON THE REMEDIES EMPLOYED FOR THE TREATMENT OF DISEASES OF THE HEART.

The subject continued; observations on the incrementitious processes; their importance in the treatment of diseases of the heart; dietetics; stomachics; hæmatics; neurotics, absorbents, and derivatives.

The incrementitious Processes.

HAVING pointed out the important share which the excrementitious processes have in preserving health, the different artificial means which we possess for imitating them, and the application of these means in the treatment of the diseases of the heart, we come next to review the *incrementitious* processes, or those by which the body is supplied with the elements which are separated from the blood, and from the atmosphere, and which are necessary for converting the food into chyle, and for the oxygenation of the blood. In prosecuting our inquiries upon this subject, we shall find that, besides varieties in the aliments and drinks, there are medicinal agents, by the administration of which we are able to assist and to correct derangements in these incrementitious processes, just as we have found that by another class of medicines we are able to correct and imitate the different excretions. The incrementitious processes become therefore no less interesting to the therapeutic inquirer than the excrementitious; for whilst the condition of the body is influenced by any derangement in the functions of those organs which discharge from it those matters which are hurtful, in an equal degree is the health of the human frame interrupted by any irregularity or imperfection in the execution of those functions which supply it with the elements of nourishment. There is, indeed, no system of the animal œconomy which is more affected by imperfections of the incrementitious processes than the sanguineous, and

Importance of the incrementitious processes.

Their influence on the heart.

we might anticipate that changes in the qualities, or in the supply of the elements which are necessary to repair the blood, might produce such changes in the vital fluid as would more or less disturb the functions of the heart.

They are performed by the same organs as the excrementitious processes.

Difference in the nature of the two processes

The same organs which perform the excrementitious, also perform the incrementitious processes, excepting the kidneys. The skin, the lungs, and the alimentary canal, not only excrete, but they are each employed to absorb from the aliment and inhale from the atmosphere those substances required for the subsistence of life. And, contrasted with one another, nothing can be more opposite than the nature of the incrementitious and the excrementitious products; for whilst some of those of *excretion* resemble inorganized compounds that can be made in the chemical laboratory, such as phosphate of lime or carbonic acid, those of *incretion* cannot be imitated. The chemist cannot compound chyle, and there is no more remarkable difference in the processes which are performed in the living body, and in the chemical laboratory, than the length of time which is required to form some of those compounds which are so quickly made in the vital laboratory. "In nothing, indeed, do these processes differ from those of the chemist more than in the short time which is required to convert matters in the stomach into acid compounds, with the lengthened period which is necessary to produce in them a similar change when out of the body."

Paris's Pharmacologia.

Nature of incrementitious products.

The incrementitious compounds may be properly said to contain all the elements of animal life, and after these compounds have been added to the blood, they are again variously decomposed, and new products formed by the different organs. Thus, in one of the vital laboratories, *combustion* takes place in order to produce animal heat; in another, the *muscular* fibre is eliminated, for the purposes of locomotion and the circulation of the fluids; in another, *bone*, upon which the whole solid fabric is built, to give insertion to the muscles and protect the vital organs; in another, is produced the *cerebral* pulp through the medium of which the vital power acts and endows the various organs with their necessary sensibility; and, in another, the *fluids*, such as synovia, are compounded, which serve the purpose of lubricating those surfaces which are required to move upon one another.

The incrementitious products are either fluid, or they are gaseous. The fluids are compounded from the aliment by the digestive organs, and they are also absorbed by the cutaneous lymphatics. The gaseous are obtained in the lungs, as well as the skin, by the decomposition of the atmospheric air.

Incrementitious corpuscules, or atoms derived from these two vital laboratories are mixed with the venous and arterial blood; and thus furnished with the elements of life, the arterial blood is distributed to the various organs, and by these it is converted into new compounds, so that in the treatment of the diseases of the heart it is essential to consider the condition of each of these incrementitious processes; for as the qualities of the blood depend upon their products, every deviation from their healthy state must more or less influence the heart's functions.

"There are some juices or humours which, in particular cases, ought to be evacuated or drawn out of the body; *and some others that you ought to restore to the body, or cause to be produced therein.*" Hippocrates.

In the treatment of cardiac diseases, whether arising from the state of the blood, or aggravated by its morbid condition, the means which we possess for regulating and assisting these incrementitious processes open an important field of pathological inquiry.

Dietetics.—The incrementitious processes which are performed by the digestive organs may be said to commence in the mouth. There the food undergoes mastication, is mixed with the saliva, passes into the stomach, where it mixes with the gastric juice, and is converted into a homogeneous pulp or chyme. It afterwards enters into the duodenum, where it undergoes additional combinations, being there mixed with the pancreatic juice, the bile, and the excretion from the duodenum.

In this course the aliment undergoes various changes by the operations of the vital laboratory, the excrementitious portions as we have already seen, being separated, and passing off through the intestinal canal, and discharged from the body, whilst the *incrementitious* portions are absorbed and conveyed to the blood.

The important purposes which these incrementitious processes serve in the animal economy, points out the necessity of proper food to preserve the blood in a healthy state; and at the same time it shows the propriety of administering in the diseases of the sanguiferous system, those medicinal substances which are known to preserve and improve the condition of the digestive organs, if these are deranged.

See page 293. I have already had occasion to remark how man, like the rest of the animal creation, is endowed with *instincts*, by which he is enabled to select the kinds of food and drink which are necessary for his existence; and that these instincts guide him in the selection of proper aliments in sickness as well as in health. But these instincts are not alone sufficient for this essential purpose of the animal œconomy: so that we are also provided with the senses of *taste* and of *smell*, which are so placed that they perform the duty of sentinels, guarding the stomach from receiving any improper food, which, guided by instinct alone, we might not have rejected.

And, further, it appears to be a law of the animal economy that these instincts and these senses shall obey and be subservient to the varied conditions of the body; that the food which is most grateful to him in health, shall be rejected in sickness; and that which is unpalatable to those who are in health, shall be agreeable to the sick. When, therefore, we contemplate the digestive process, the function where it is not improbable the agency of the *vital* principle is first developed, and when we inquire into its disordered states, and the means of relieving these, we are led to seek for those therapeutic means by which we can imitate or assist that process.

So intimately, indeed, as the functions of the heart are associated with those of the digestive canal in the healthy state of the body, we need not be surprised to find a disordered heart powerfully influenced by disturbances in the digestive apparatus; but not only do we find that there is no disease of the heart, the symptoms of which are not aggravated by a derangement of the stomach, but that there are many disorders of the heart which are caused alone by disorders of the digestive organs.

See page 136.

Whilst man, like the rest of the animal creation, is endowed with instincts and the senses of taste and smell to guide him in the selection of his food, it must also be borne in mind that these instincts are under the influence of his *will*, and consequently we find that from the habits of civilised life and the various culinary arts which have been contrived to increase our animal gratifications, the digestive organs are subject to a variety of disorders.

Thus, it is not the uneducated classes of the community who are the greatest slaves to and the most severe sufferers from sensual gratifications. In proportion as man becomes refined, he studies and practises the "gastronomic" art; so that in the practice of medicine amongst the polished and the learned, the physician finds his advice little sought for if he endeavour too rigidly to check them in their animal propensities. No man ever acquired greater reputation in the class of society to which I allude than one whose practice I had often observed, and who on no occasion ever omitted to point out, and to contrive some food that would be pleasing and gratifying to the patient, however improper it might be for his recovery. "I always," said he, "allow my patients to eat and drink what they like. This pleases them better, and they take more of my physic."

Food of an improper quality, taken at irregular meals, or in an improper quantity, will, by deranging the stomach, more or less aggravate all the symptoms of a disordered heart; and, therefore, each of these points deserves attention in regulating the diet of those suffering from a disturbed circulation.

The proper quality of the food.

With regard to the *quality* of the food, most persons are perfectly aware of those kinds of food which they cannot easily digest, so that all such aliments should be avoided, and those kinds only should be partaken of which experience has taught are of the most easy digestion. Animals can, by gradual habit, live upon food that is not the natural aliment of their species; and so man, in various parts of the globe, lives upon very different kinds of food. I have long been in the habit of directing the sick always to partake of the kind of aliment which he most desires; for it is impossible to dictate, from any appearances of the tongue, of the skin, or of the pulse, to the inclinations and tastes of different individuals; and we constantly observe persons recovering from a severe illness, or suffering from some chronic derangement of the digestive organs, express a great desire for some particular kind of food, and usually for such as they dislike when in health. And I have never had occasion to regret recommending to the sick this rule of choosing their own aliment, provided always that the food or drink was not suggested by any person to the patient, and that it was taken only in a *moderate* quantity. Where an opposite rule is followed, especially in those suffering from diseases of a febrile type, and wherein the heart is much excited, if animal food, particularly in a solid form, be prescribed, it seldom fails to aggravate all the febrile symptoms, and instances are not very rare in which fatal effects have resulted from a patient eating even a small quantity of animal food during, and in those apparently recovering from, diseases of an inflammatory character. Several persons who were burnt at the fire of Covent Garden and admitted into St. Bartholomew's Hospital, and who were fast recovering, had a quantity of food sent to them, in consequence of eating which consecutive fever came on, and they all perished! In conclusion I may remark, that this rule for regulating the diet of the sick is in accordance with what we observe throughout the animal kingdom, all animals, both when in health and suffering from disease, selecting particular kinds of food, and such food as under other circumstances might be hurtful to them. Thus many animals, as I before mentioned, under particular circumstances, eat substances to cause vomiting or purging; at other times they resort to salt-springs, or the sea-shore.

Baillie's posthumous Works.

Abernethy.

See page 294.

The proper quantity of food.

In regulating the diet it has long appeared to me, that the chief point to inculcate for the guidance of the sick, is moderation in the *quantity* of food taken at each meal. The palate may never fail to be a safe guide for selecting the proper quality of food, though most persons require to make an effort in order to limit the quantity of a meal, and avoid eating to repletion; and if the whole bulk of a meal be moderate, any disordered state of the heart will suffer little from the condition of the stomach. "I have often heard Napoleon say," observes his biographer, "that however little nourishment people took at dinner, they always took too much. Thus the Emperor's head was always clear and his labours easy, even when he rose from table." Such is the influence of digestion upon the circulation, that the vigour of the mind, as well as that of the physical frame, is greatly diminished by over-indulgence in food; and those whose mental avocations are intense and laborious, or whose bodily exertions are great, are never able, without more or less suffering, to indulge in habits of repletion.

Bourienne.

The meals should be regular.

Besides attention to the quality and to the quantity of the food, the *regularity* of the meals is of great consequence; and of this every one is aware from personal experience. The number of meals and the time when they are made is very different with different persons,—depending upon the avocations of each; and such differences do not appear to interfere with the enjoyment of health.

But any irregularity and, above all, taking even a very small portion of food between the accustomed meals, is often the cause of greatly disturbing digestion; and as the desire of food comes on at the period of the usual meals, if it be not taken when the stomach has made the requisite preparation for its reception, digestion becomes always more difficult and often very imperfect.

Medicines improve the incrementitious processes,

However strict may be the attention paid in selecting, in limiting the quantity, and in regulating the periods for taking food, yet from our habits, as well as from the numerous maladies to which mankind is liable, it often happens that the digestive function is impaired, and that it can be materially improved by the administration of appropriate medicines. Let us therefore proceed next to the consideration of those medicinal substances which assist the digestive processes, and which extract from the aliment those products which are to be absorbed and conveyed to the blood, and likewise those medicines which pass from the digestive canal to the blood unchanged, and where, by their presence in the vital stream they produce curative effects on the disorders of the heart. These different medicinal substances may be appropiately classed amongst the ***stomachics***, the ***hæmatics***, the ***neurotics***, and the ***absorbents***, and each of these classes merit a separate consideration.

When medicinal substances are received into the stomach they and their different modes of action.

are either simply mixed with the food, or they undergo changes in the vital laboratory, and are formed into new compounds with the contents of the stomach, which products are afterwards absorbed and mixed with the blood; and there are others which pass through the alimentary canal without being changed in their qualities, or diminished in their quantity.

Their utility in the treatment of diseases of the heart.

The phenomena which are manifested in these different modes by which medicinal substances act upon the *primæ viæ* are extremely interesting, and enable us to adopt certain principles, in order to regulate the treatment of disease; and there is no class of ailments where such principles can be so aptly applied as in the treatment of the diseases of the sanguineous system.

The stomach may justly be considered as the "centre of sympathy," when we reflect on the extraordinary influence which the *ingesta* exercise upon the system; for whatever is received into the stomach, either in the shape of food or medicine, has, doubtless, a direct action upon its tissues, whatever may be the subsequent effects produced on other organs.

General laws to be observed in the action of medicines.

And this leads me further to observe with regard to medicinal substances, that the more successfully we explore the phenomena of the animal œconomy, and the more attentively we observe the effects of medicines upon the different organs, the better are we enabled to trace these effects to some general laws; and however numerous and multiplied be the facts which empiricism has furnished, and however unsuccessful therapeutic inquirers may have hitherto been in revealing any general principles by which medicinal substances produce their varied influence upon the œconomy, I am fully persuaded, that both physiological and chemical science have already advanced far enough to enable us, by legitimate induction, to explain certain laws which are established in the animal œconomy, and under the control of which medicines, as well as aliments, act upon the body.

These laws defined.

One of these laws seems to be that every medicinal substance has its influence on one organ, or upon one system of organs; and another is, that by whatever channel medicinal substances are conveyed to the blood, their effects upon a particular organ or system are always similar.

Now both these laws of the œconomy are illustrated and fully confirmed by a multitude of phenomena. That every medicinal body acts upon a particular organ, or on a particular system, is a fact universally established, and on a knowledge of which is based the science of therapeutics. That medicinal substances not only act upon one system, but upon different portions of a system, the cerebro-spinal system affords an excellent illustration; *neurotics*, properly so called, each affecting particular portions of the cerebro-spinal and ganglionic systems. Opium acts upon the brain, chloroform upon the sensory, and strichnine upon the motor column of the spinal chord.

Their analogy to the phenomena of disease.

And, I may repeat the observation, that this law, in regard to the special effects of medicines, is strictly analogous to the phenomena of diseases; these usually affecting a particular system, or a particular portion of that system. Thus, we have seen that each of the different systems of the œconomy may be separately affected by derangements of the circulation; and not only the different systems, but even different portions of these systems, striking examples of which, I have already mentioned, may be observed when the heart is diseased in the different portions of the cerebro-spinal system.

This analogy of the influence of medicinal substances to the phenomena of disease is of great value, as it points out a rational method, both for the arrangement and administration of the various substances of the *materia medica;* and the practical importance of which will appear when considering the effects of medicines in the treatment of the numerous diseases of the heart.

Another law is, that medicinal substances produce similar effects whether they enter the blood by the absorbents of the alimentary canal, or by the pulmonary, or by the cutaneous absorbents. That their effects are the same, by whatever of these portions of the absorbent system they may have been conveyed to the blood, is shown by some of the most powerful therapeutic agents. Arsenic, whether it be taken into the stomach, applied to the skin, or to the surface of an ulcer, produces precisely similar effects, inflaming the mucous membrane of the stomach and rectum, and leaving unaffected the intermediate portion of that tunic of the intestinal canal. Tobacco, chloroform, and æther produce similar effects on the circulation, whether they are taken into the stomach, inhaled by the lungs, or applied to the skin; and cantharides causes stranguary, and emetic tartar nausea, whether they be taken into the stomach or applied to the skin to produce vessication. There are purgative medicines which act upon the alimentary canal, whether they have been absorbed by the skin, inhaled by the lungs, applied to the tongue, or received into the stomach; and it matters not whether mercury be swallowed, absorbed by the skin, or inhaled by the lungs, in order to cause salivation; nor whether belladonna be swallowed or rubbed upon the skin to produce its specific effect upon the iris. And it is the same with opium and strychnine, their medicinal effects being produced whether they are swallowed, inhaled, or applied to the cutaneous surface. To conclude, I may observe in evidence of this law of the œconomy that the same effects were produced by injecting *emetine* into the cavities of the pleura and into the parinchema of different organs. Magendie.

Stomachics.—The stomach may not be inaptly considered as a central laboratory in which is performed both incrementitious and excrementitious processes, and from which the products of both processes are removed, the one being conveyed to the blood by the absorbents, and the other discharged by the intestinal canal.

Stomachic medicines, properly so called, are those substances that act either directly upon the tissues of the stomach, or that when mixed with the food and assisted by the operations of the vital laboratory, render it more easily convertible into chyle; and as the condition of the whole animal frame greatly depends on the manner in which the incrementitious processes are performed, stomachics may be deemed an important class of remedies in the treatment of some of the diseases of the heart. These medicines have been classed amongst the *tonics* and *astringents*, some amongst the *carminatives*, others amongst the *aromatics*, some amongst the *corroborants*, and some amongst the *anti-spasmodics*, affording another proof of the unphilosophical methods which have been contrived to classify the various objects of the materia medica, arranging them according to some hypothetical opinion of their modes of action upon the animal œconomy.

When medicinal bodies are received into the stomach, whether they be mixed with its contents and form with them new compounds, whether they are conveyed by the absorbent vessels into the blood, or whether they pass through the intestinal canal unchanged, the special effects of each are produced by their influence upon the different tissues of the stomach, some acting upon the vascular, some upon the absorbent, and some upon the nervous structures ; others appear to act upon the mucous and the muscular coats, whilst those medicines which are absorbed unchanged and mixed with the blood, influence the functions of the heart, either by coming into direct contact with the lining membrane of its cavities, by entering into its structures through the cardiac arteries, or by their influence upon the whole, or only upon a portion, of the cerebro-spinal system.

There are certain medicinal substances, such as the *vegetable acids*, the *alkalis*, and some of the *saline* compounds, as the *muriate of soda*, which, whenever they enter the stomach, form compounds, chemically mixing with the food, by which they render its assimilation more easily performed, or by which they are enabled to form new compounds to be mixed with the blood. But how far either medicinal or alimentary bodies act directly on the tissues of the stomach, or are first absorbed by the blood, many discrepant conjectures have been made. That they must cause certain changes on the tissues of the stomach appears, however, probable from the almost instantaneous effects which some of them produce, and the sensations which they create, not only on the stomach itself, but throughout the whole system. There are analogous examples of the action of medicines upon other organs when they are directly applied to them, such as the effects of colyria and injections into the intestines, the urethra, and into the vagina. Barbier.

"That *medicines* showing considerable powers with respect to the whole system, act especially or only on the *stomach*, will appear from all those cases in which the effects are seen soon after the substance has been taken into the stomach, and before they can be supposed to have gone further into the body, or to have reached the mass of blood." Cullen's Mat. Med.

Besides, those substances which enter the blood must, in the first place, produce certain impressions on the tissues of the stomach, more especially upon its absorbents. On the other hand, there is no doubt of the rapidity with which substances taken into the stomach reach the heart; and when we consider the velocity of the blood's stream, it is easy to explain how quickly any particular organ should become influenced through the medium of the blood by such medicinal bodies as act upon it.

But, as has been said, those medicines which act upon the coats of the stomach do not make their impression upon all of them indiscriminately, each appearing to produce its effects upon one particular tissue. Thus some act upon the mucous, some upon the capillary, some upon the absorbent and muscular, and some upon the nervous tissue; so that a variety of effects are produced by medicinal substances when received into the stomach, one producing an increase, and another a diminution of the vigour of the capillaries; another increasing or subduing the mucous secretions, and another making an impression upon the gastric nerves.

Those medicines whose action appears to be limited to the stomach, and which pass through the alimentary canal without being diminished in quantity or changed in their quality, are the *tonics* and *astringents;* and in the disorders of the circulation, which are symptomatic of an impaired digestion, or in those which are aggravated by it, the use of stomachics is essential for their relief. At the same time, in the treatment of the diseases of the heart this class of remedies will often prove injurious, and great discrimination is therefore necessary in administering them.

The most powerful vegetable tonics contain both a *bitter* and an *aromatic* element, and of these none are more useful in assisting digestion than *hops* and *aloes.* Animals, as well as man, are instinctively impelled to eat substances when they are out of health, in order to assist the digestion of the food; and "no cattle will thrive upon grasses which do not contain a portion of bitter extractive." Even the inhalation of the odour from the flowers of the hop has an extraordinary beneficial effect upon the sick; and in Kent, where it is extensively cultivated, those employed in collecting the flowers are so greatly improved in their health that many persons who are enfeebled quit the

Paris's Pharmacologia.

metropolis to "pick hops," and return to their homes with their appetite and strength materially improved.

Effects of tea and coffee.

The salutary as well as the injurious effects of those vegetable substances which contain the astringent principle are illustrated in the use of *tea* and of *coffee*, a moderate quantity of either improving digestion, while a larger disturbs the heart—causes restlessness and prevents sleep. The injurious effects of tea, however, seems to depend chiefly on the quantity of *tannine* which is contained in the infusion that is used, for if the leaves have been infused a sufficient time to extract only the *theine*, and none of the *tannine* which they contain in so considerable a proportion, then no hurtful effects are produced on the general circulation. But *coffee*, as it is usually prepared, always contains, besides *caffeine*, a certain quantity of *tannine*, and this is the cause of coffee, particularly when taken at a late hour, so frequently disturbing the heart and causing wakefulness; whereas, when it is drank after a meal, in a comparatively small quantity, and without milk, by acting as a stomachic, it assists the digestion of the food. In those suffering from affections of the heart, both tea and coffee are to be made use with caution;* and there are many instances of persons whose heart has been greatly disturbed, who have been completely relieved merely by discontinuing these beverages. On the other hand, it sometimes happens, though rarely, that a disordered circulation has been relieved by their use. "A young lady had violent nervous palpitations; finding that the usual remedies had been prescribed without any relief, I suggested that a strong infusion of *green tea* should be given three or four times a day, and continued for a few days; relief followed, and perfect recovery in two or three days."

Copeland's Med. Dictionary.

Effects of tonics and astringents.

These remarks on the effects which are produced by the use of tea and coffee upon the heart's action are strictly applicable to other vegetable tonics and astringents, and likewise to the preparations of iron, copper, and lead, these being not only absorbed from the alimentary canal, and conveyed to the blood, as we see exemplified in the treatment of many diseases of the circulation wherein the qualities of the blood are changed; but they also act as tonics or astringents upon the tissues of the stomach.

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* It has been ascertained that caffeine and theine contain the same element.

Nothing is more remarkable than the difference in the effects of these remedies in persons who have an irritable heart, and in those whose circulation is languid from the heart being unable vigorously to propel the blood. In the first description of cases, tonics in place of tranquillizing, increase the heart's action; and it is not unusual for patients, however greatly their general health may be enfeebled, to make the remark that they cannot bear any description of *tonics,* all such medicines causing heat of the skin, flushing of the face, and general restlessness. Those of an opposite temperament, on the other hand, and in whom both the cardiac and arterial pulse is feeble and languid, have their health improved by tonics and medicinal substances that contain *bitter extractives.*

and of Carminatives.

In disturbances of the heart it is always of importance to arrest any over-distention of the stomach, for such is its relative position to the heart, that when replete it interrupts by its pressure the heart's movements, and the more so when an attempt is made to lay in a horizontal position.* To relieve flatulency *carminatives* are usually resorted to, such as *peppers* or *ginger,* either taken singly or combined with rhubarb, and taken immediately before a meal; or a *galbanum* pill, with or without aloes, often greatly assists the digestive process.

Hæmatics.—Besides those disturbances in the functions of the heart which are caused by changes in its supply of blood, there is another and a very numerous class of disorders which are caused by changes in the *qualities* of the blood; and as the blood is the natural stimulus of the heart, every change in its qualities necessarily deranges its functions, *hæmatics* may be justly considered a very important class of remedies in the treatment of disorders of the circulation.

During the progress of disease we constantly observe the sick changing his food and drinks, being impelled by instinct to make choice of those which are best fitted to relieve the symptoms of his ailment. Hence it is that he who is suffering from a febrile disease rejects animal food, and freely partakes of diluent drinks; See page 289. the stomach, during fever, being quite incapable of digesting solid aliments; whereas diluent drinks are easily absorbed, and cause a copious perspiration, by which the febrile symptoms are mitigated. Others of the sick desire to live on vegetable food, or fruits, whilst some can best digest animal food; some choose salted, and others fresh meat; some select acidulated drinks; and the gratification of these peculiarities in taste is generally found not only to be the most palatable, but the most easy of digestion, and therefore the most appropriate.

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* Hale remarks that, "the flatulent are often subject to *vertigo* from the wind distending the gullet, and pressing upon the descending aorta, whereby the blood is driven too forcibly to the superior parts."

The animal œconomy is thus endowed with means by which the healthy condition of the blood may be restored, and there are medicinal substances which, when conveyed to the blood have specific effects in changing its qualities. Experiments have shown Barbier Mat. Med. Paris, 1820. that the molecules of medicinal bodies absorbed and mixed with the blood are found in that fluid throughout the body, but these molecules act only on particular organs, affording a striking proof of the general law which I have pointed out. Madder reddens the bones, the milk soon partakes of any aliment which the mother may have taken; and there are other substances which, being unfit to be retained in the blood, pass directly to the organs of excretion, and are by them discharged from the system. Thus we can explain how the urine is so easily affected by certain medicines, for the kidney is that organ by which the system expels those substances which are mixed with the blood that are noxious, or that are not susceptible of assimilation.

Of the nature of the *chemico-vital* changes which take place in the blood of different organs we are perfectly ignorant, and we are but little acquainted with the difference in the venous blood which is returned from each organ; for as every organ secretes from the blood a different product, so it must happen that the venous blood from each organ must be different, differences which have not yet been satisfactorily analyzed.

To remedy disorders of the heart depending upon a morbid condition of the blood, we possess a variety of medicinal bodies, by some of which the qualities of the whole mass of the vital fluid can be changed, whilst others remain in the blood unchanged and are conveyed by it to particular organs. And those medicines that enter the blood, either produce their influence on the sanguineous system by their direct contact with the surface of the vessels, such as the preparations of antimony, iron, copper, silver, and lead, and the alkalis; or they make an impression upon the nervous system, as opium, digitalis, and other neurotics.

See page 345.

When inquiring into the remedial effects of nausea and vomiting, I had occasion to remark, that there was no medicinal substance which had a more powerful influence upon the heart than the preparations of *antimony*. The virulent disputes which medical history affords in reference to the effects of this medicine exhibit such a discrepancy of opinion, and even such a distortion of facts, that it is impossible to avoid impugning the veracity of some of the disputants. Antimony, at least the *tartarized antimony*, is now, however, universally admitted to occupy a prominent place in the materia medica, and is justly considered as one of the most important medicines employed in the treatment of diseases of the circulation.

That the *tartarized antimony* acts powerfully upon the heart there is the most incontrovertible evidence afforded by examining the phenomena which follow its exhibition, and particularly by observing its influence upon the functions of the heart when these are deranged. Whether these effects are caused by its coming into contact with the heart's surface when mixed with the blood, or whether it be the cerebro-spinal system which is first influenced and subsequently the cardiac and pneumo-gastric nerves, it is sufficient for our present inquiry to point out the curative effects which are produced by its exhibition in the diseases of the circulation.

Utility of antimonials.

Besides the influence of the *tartarized antimony* in creating nausea and vomiting, there are other effects produced by it on the sanguineous system, and whatever may be the explanation that is given of its mode of action, there is no doubt of the decided benefit derived from its administration in disorders of the heart; more especially in those functional disturbances caused by congestion, as well as in affections which are of an inflammatory character.

I may remark generally, that in all those functional ailments of the heart wherein it has been found expedient to abstract blood, the subsequent use of the tartarite of antimony is almost always useful; and in affections of an inflammatory type, and in those wherein depletion has been already employed, the effects of this medicine are decidedly beneficial. In both cases, the sensible influence of the antimony is to diminish the heart's impulse and the frequency of the arterial pulse; and these effects may be produced to any degree, by regulating the dose of the medicine.

In functional diseases of the heart.

In inflammatory affections.

So powerful are the effects of antimony on the circulation that it has often been employed in place of bloodletting, so that whether the vigour of the circulation be reduced by abstracting a portion of the vital element, or by the influence of this medicine on the circulatory apparatus, the effect upon an inflamed organ appears to be in many respects analogous.

Rasori.

In the use of the *tartarized antimony* the same discrimination is required in conducting its administration as other active remedies. Different cases require not so much differences in the quantity of the dose as in the frequency of repeating the doses. In some it is sufficient to tranquillize the heart, whereas in others nausea, or even vomiting, are desirable; but in all cases its use need not be persevered in longer than the symptoms continue for which it has been administered; for it is extraordinary how great a depression it sometimes causes when given beyond a certain time, or after the inflammatory symptoms have been subdued.

How to be administered.

That the long-continued use of antimony sometimes causes *salivation* I have met with repeated proofs, and therefore its effects on the mucous membrane of the mouth, as well as on the salivary glands, should not be disregarded.*

Salivation caused by its use.

There are two preparations of antimony,—the *tartrate* and the celebrated fever powder of *James*, which are applicable to the treatment of diseases of the heart, and from these all the curative effects of antimony may be derived. The tartrate of antimony can be given, either in solution or in pills, or the salt may be put upon the tongue.

When the digestive organs are not in a deranged condition a pill composed of ¼ or ⅓ of a grain of the tartrate of antimony combined with a grain of extract of rhubarb and of soap will seldom cause sickness, especially if the stomach be not quite empty; and therefore I always recommend patients to take a single mouthful of bread or biscuit, immediately before swallowing the pill, by which means nausea is very generally prevented; and to avoid the influence which the mind might have in causing sickness, it is prudent not to allude or prepare the patient for the possibility of such an occurrence.

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* James met with six cases where salivation took place from the use of his fever powder.

It not unfrequently happens, however, that the first doses of the antimony which are taken cause nausea and vomiting, but subsequently it may be long continued without producing any perceptible effect upon the stomach; and, on the other hand, it does not unfrequently happen that the first doses of this medicine have no effect on the digestive organs, but cause nausea and vomiting after having been taken for a considerable length of time, antimony being one of those medicinal substances whose effects are sometimes *cumulative*.

When the tartrate of antimony is to be given in solution, this is usually done by combining it with some neutral salt—such as the tartrate of soda, the sulphate of magnesia, or the supertartrate of potass, the effect of which seems to be further to cause the antimony to act upon the intestinal canal.

Antimony, combined with other medicines, will also be found a useful remedy in many affections of the heart. Its combinations with *gummy* and *saponaceous* substances has long been extolled, and on this principle are compounded the celebrated pills both of Smucker and of Richter.

See Appendix O.

With *mercury* it forms a very active compound, and generally in the inflammatory affections of the heart one grain of calomel with two or three of James's powder given every six, eight, or twelve hours, according to the severity of the symptoms, has a most powerful effect in tranquillising the circulation, as well as acting on the digestive and cutaneous systems.

A similar dose taken occasionally is sometimes very effectual in relieving *chronic* affections of the heart. I say occasionally, because there are many individuals whose biliary organs are at the same time deranged, and who may be much benefited by one or more doses of this compound, but who suffer exceedingly from the too frequent repetition of it, the mercury in such instances rendering the heart irritable and increasing the number of its pulsations – a state, I may here mention, which, when it does take place, is relieved by camphor and ammonia.

Antimony, too, especially in the form of "James's powder," may be combined with digitalis, and with colchicum, each of which are found to be important remedies in some affections of the heart.

James's powder is a form in which antimony has been much used, and though its mode of preparation has never been discovered, its utility is universally admitted; and in the treatment of disorders of the heart I consider it to be oftentimes a milder and more easily manageable preparation of antimony than the tartrate, and is less apt to create nausea and disturbance of the stomach. As not unfrequently when taken singly it creates headach with heat of skin; given combined with a grain of aloes or rhubarb, these effects are generally prevented. In this manner four or five grains may be given in chronic disorders of the heart, and continued daily for a very considerable time with the best effects.

Influence of antimony on mucous membranes.

The curative effects of the tartrate of antimony in the diseases of the heart are derived from other sources, besides its influence on the organs of circulation. Its action is equally powerful on the *gastro-pulmonary* mucous membrane, and as many diseases of the heart are accompanied by affections either of the pulmonary, of the gastric, or of both portions of that membrane, the tartrate of antimony will be found a most active therapeutic agent. In such cases great benefit arises from giving the medicine in doses sufficient to create nausea, or even vomiting; the act of vomiting removing not only any inordinate quantity of mucus collected in the stomach, but also evacuating it from the bronchi.

As an *expectorant* this medicine has long been extolled, and its specific influence upon the gastro-pulmonary mucous membrane has been amply confirmed by experiments. Injected into the veins, it causes inflammation of the whole lining of the intestinal canal, especially of the mucous membrane of the stomach, duodenum, and rectum; and in a case where a table-spoonful of the tartrate of antimony was swallowed by mistake, besides other effects, "the whole body was covered, three days after the medicine had been taken, with genuine tartar-emetic *pustules*."

Case recorded by Dr. Gleaves.

Hurtful effects of antimony.

I have already had occasion to remark how requisite it is, when exhibiting the tartar-emetic, carefully to watch its effects, these often producing great depression of the vital powers, and sometimes preventing sleep; and medical records afford examples of persons who have sunk under the influence of nauseating doses of that medicine. When given in too large a dose the violence of its action may be arrested by a decoction of cinchona, or any substance which contains *gallic acid*, provided that the antimonial salt has not left the stomach.

Barbier Mat. Med.

Effects of mercury on the blood.

See page 240.

With regard to the effects of *mercury* in the treatment of the diseases of the heart, I have already noticed that it is employed in its inflammatory affections as advantageously as it is in the same class of maladies in other organs, and likewise in those ailments of a chronic character wherein the hepatic system is also deranged. I likewise alluded to the peculiar, and, indeed, sometimes poisonous effects which it produces on the heart when mixed with the blood, a circumstance that well merits attention in the administration of mercurial medicines.

The preparations of *lead*, of *iron*, of *copper*, of *zinc*, and of *silver*, are all remedies which have, by the changes which they produce on the qualities of the blood, a specific effect on the action of the heart, and I have grouped them together, as their effects are very analogous; whereas antimony and mercury have an influence on the circulation of a very different character.

Effects of lead.

Preparations of either of these different minerals may be most beneficially employed in disorders of the circulation, and that of *lead* is perhaps the most remarkable. Of this we have a striking example in the exhibition of the *acetate of lead* in pulmonary hæmorrhage symptomatic of cardiac congestion, for arresting which there is no more powerful remedy, especially when combined with *opium*. Besides, I am convinced that the good effects of lead are not merely to stem the bleeding, but that, like the preparations of iron, zinc, and copper, the use of the acetate of lead may be continued with great advantage in such cases for a lengthened period, and after all tendency to hæmoptoe has ceased.

Of the metallic salts, those of *iron* are chiefly in use for the treatment of those conditions of the circulation arising from changes in the blood's qualities; and there is no preparation more to be depended upon than the *sulphate* of iron. From half a grain to a grain of this metallic salt, combined with the extract of gentian, or with the compound galbanum, or myrrh pill, may be taken two or three times a day; and when it is necessary to regulate the bowels, half a grain of the powder of aloes may be added to the pill.

Effects of iron.

What has been said of the use of iron is applicable to the preparations of *copper* and of *zinc*, the *sulphates* of both these metals having effects on the heart very analogous to that of iron; and they are usually given in the same doses. As regards the *nitrate* of silver, the diseases in which it has been beneficially employed, are of various characters, and though no rational explanations of its effects have been given, yet I am persuaded that it relieves disorders of the circulation by changing the qualities of the blood.

Effects of copper and of zinc; and of silver.

The erroneous notion of increasing the *quantity* of a medicine according to the urgency of the symptoms of a disease, is fully verified in the use of these different metallic salts; for when these are given in large doses, they have either less influence than when taken in smaller doses, or they are absolutely not absorbed at all, but pass through the alimentary canal unchanged.

See page 365.

There is no class of medicinal substances which have longer preserved a high reputation for their curative effects upon the blood than the *alkalies*. And in those disorders of the heart wherein the qualities of the blood are changed, such as in rheumatism, gout, and scrofula, the alkalies are most useful remedies. The carbonates of *potass* and *soda* combined with *cinchona*, or with rhubarb, and, above all, the combination of potass with iodine—the *hydriodate of potass*, is a most efficacious remedy, especially in those cases where the heart has suffered any inflammatory disease, and where there is reason to suspect that some sero-albuminous effusion has not been absorbed.

Effects of alkalies.

Neurotics.—Having taken a general view of those remedial means which diminish and increase the quantity of blood within the heart, and also those by which the nature of the blood itself can be altered, when that fluid is changed by disease, we come next to consider the medicinal substances which act upon the *nervous* system; and these form a most important class of remedies in the treatment of the diseases of the heart; the functions of the heart and the nervous system being so intimately associated, that every change which medicines produce upon the functions of the one of these vital organs, is always accompanied with a reciprocal influence upon the other.

There are three different channels by which medicinal substances may be employed to influence the nervous system: the alimentary canal, the lungs, and the skin; and it matters not whether camphor, valerian, or ether, be received into the stomach, be inhaled by the lungs, or be applied to the skin; for in whichever of these channels they are administered, the effects they produce on the cerebro-spinal system are precisely similar. Besides their immediate influence upon the pneumo-gastric and cutaneous nerves, *neurotics* also make an impression upon other nerves, after they have been absorbed and conveyed to the blood, and brought into immediate contact by the vital stream with the sanguiferous system.

The influence of different *neurotics* and of different doses of them upon different portions of the cerebro-spinal system affords a most striking illustration of that law of the animal œconomy which I have already endeavoured to point out; and still more strikingly is this law illustrated by the difference in the effects which are produced by the different elementary parts of these substances when they are used separately. The *oil* of tobacco stops the heart's action; and the *infusion* which contains *nicotin* makes its impression on the brain. Brodie. *Opium*, in its crude form, acts upon the whole nervous system as a stimulant, as a sedative, as a narcotic, or as a hypnotic; but *morphine* acts only as a soporific, and *narcotine* produces only the noxious effects attributed to opium. And the same remarks apply to the observations which I formerly made on the effects of tea and coffee, when these were prepared so as to be deprived of certain of their elements. See page 367.

Neurotics, which form a very important class of medicinal bodies, have been arranged according as they influence particular portions of the cerebro-spinal system. Hence we have those which assuage pain, or the *narcotics;* those that promote sleep, or the *hypnotics* or *soporifics;* those which allay irregular muscular contractions, or the *anti-spasmodics;* those that cause excitement, or the *stimulants;* and those that depress the energy of the nervous system, or the *sedatives.* But the practical imperfection of this classification has arisen from the same neurotic medicines acting either as hypnotics, narcotics, anti-spasmodics, or sedatives, these different effects chiefly depending upon the dose of the medicine which has been administered.

Quantity of sleep necessary.

Of these different effects of *neurotics,* there is no one of more general application and more useful than in procuring *sleep.* A diminution in the waste of the body is as essential for its preservation as a due supply of the *incretions,* so that sleep and digestion may, in these respects, be considered to perform as it were synonymous functions. However essential sleep may be for preventing waste, the quantity which is required by different persons is very considerable. Napoleon slept only four hours; Wellington always rises when during sleep he endeavours to turn himself, his couch being so narrow that he cannot attempt to change his position without awaking. The moral benefit of sleep, or the rest of the mind, seems to be derived from the slumber being complete, and awoke at such a moment when there is no inclination for more sleep.

Curative effects of sleep.

But the beneficial effects of soporifics is not only to diminish the waste of the elements of nutrition, the condition of the body during perfect sleep being also the means of subjugating disease. In this respect, sleep and syncope are analogous in their effects upon the œconomy, the great diminution in the vigour of the circulation during sleep being, like in syncope, the means of checking the progress of inordinate action. On this principle I would explain the curative effects of *neurotics,* such as *opium,* in many diseases.

Soporifics.

See page 89.

Having shown that during perfect sleep it is requisite that the vigour of the heart's action should be diminished, it may be anticipated that *watchfulness* would frequently be a necessary consequence of an increased circulation; and, therefore, to promote sleep in those afflicted with a disordered heart, such means should be adopted as may be best calculated to tranquillize the circulation. This observation, however, applies chiefly to those who have a disorder of the *systemic* heart, and in whom sleep is prevented from an increase in the proportion of the arterial blood in the brain; whereas, in diseases of the *pulmonic* heart the excess of venous blood causes drowsiness, stupor, and coma.

See page 99.

Having fully explained the phenomena by which *sleep* is preceded, accompanied, and succeeded, we are now prepared, not only to give a satisfactory explanation of the various remedial means which promote or cause sleep, but we are enabled to establish rules for employing such means in those who are suffering from a disordered circulation.

Moral soporifics.

The means by which we can promote sleep are both moral and physical. There is no more powerful neurotic than the *mind*, for whether it be over-excited or depressed, its influence in causing wakefulness is equally remarkable.

> "My slumbers—if I slumber—are not sleep,
> But a continuance of enduring thought
> Which then I can resist not; *in my heart*
> *There is a vigil, and these eyes but close*
> *To look within.*"
>
> BYRON.

Those who are much involved in worldly pursuits generally have their sleep more imperfect than men who are engaged in literary or scientific investigations, and nothing contributes more to induce sleep than occupying the mind with some cheerful or some frivolous recreation for a while before retiring to rest. And, on this principle, have arisen many habits to promote sleep, such as reading works of fiction, or that are unconnected with our more serious pursuits, or such as create little interest. Monotonous sounds, as the humming of bees, the noise of a waterfall, and the sound of "sweet music," all contribute to produce sleep. There is, however, no soporific equal to mental fatigue, provided always that it has not been carried to excess; for it is the same with the mind as with the body, any great mental excitement causing restlessness and preventing sleep. WELLINGTON fell into a profound slumber the moment he retired after the battle of Waterloo, and before he could undress himself; and some men have the power to fall asleep at any time of day when their mind has been fatigued.

Soporific medicines.

Sleep may be also procured by the exhibition of those medicines which diminish the action of the heart. *Hypnotics*, according to Hippocrates, produce sleep "by calming or by giving rest to the blood;" and the account which I have given of the nature of sleep accords with this opinion of the father of medicine. Opium, hyoscyamus, digitalis, ammonia, camphor, the hydrocyanic acid and chloroform, are all in their turn employed to promote sleep by their influence in tranquillizing the heart's action.

See page 89.

Besides promoting sleep, *neurotics* are also employed in disorders of the circulation, for their *narcotic*, their *anti-spasmodic*, and their *sedative* effects.

Opium.

Of that class of medicinal substances there is no one which has so long and so justly been extolled as *opium*. The neurotic effects of opium are employed to procure sleep, to allay pain, or to diminish the vigour of the whole nervous system.

Its soporific effects.

As a *soporific* opium has been universally had recourse to, and its powers of tranquillizing the heart has made opium more frequently administered to procure sleep than any other medicinal substance. For this purpose its goods effects are generally produced by very small doses,—five or six drops of laudanum, combined with the acetate or carbonate of ammonia, the citrate of potass, or some laxative infusion, are the best mode of exhibiting it. As a general rule, opium, in whatever form it is used, should be given either in very small or in large doses, the medium dose often deranging the system generally, and to allay an irritable state of the circulation the small dose recommended as a soporific, is sufficient. An eminent statesman, besides emphysema of his lungs, had an *atrophied* heart, and the benefit he obtained from small doses of opium were remarkable. Alluding to his sufferings, he writes, "The relief is quite wondrous, and I could fall down and worship my opium pill like a Turk! What is new to me, indeed, I have got through the labours of my toilet with scarce any feeling of exertion, and I am altogether stronger and a better man than I have been a great while."

Its anodyne effects.

Memoirs of the Life of Francis Horner.

To relieve *pain* opium should be given in full doses, and freely

Its narcotic effects.

administered. "In the use of laudanum two things must be carefully observed. When once we begin with it after any evacuation, it must be given in a sufficiently large dose, and repeated often, to conquer the symptom, remitting only such a space of time between every dose as may be sufficient to inform us what the effect of the last hath had before we give another."

Sydenham.

Opium may be administered with great advantage in disorders of the heart, either singly or combined. When administered singly I know of no form preferable to the common *crude opium;* for it is with this as with many other drugs, that when *purified,* and the *medicinal* part alone preserved, the effects are often alogether changed. Thus, neither *morphine* nor *narcotine,* taken separately, have the same effects as crude opium. One grain of morphine produces no more effect than two grains of opium, and these two grains of opium contain only one-sixteenth part of a grain of morphine. This observation applies to other neurotic medicines as well as to opium. The influence upon the animal œconomy which the combinations of elementary bodies, such as those which nature has formed in the vegetable kingdom, is also met with in the combinations of various saline substances that are present in mineral waters; and if such natural waters be decomposed, and deprived of any of their component parts, however minute may be the quantity, their effects are often completely changed. In the common epsom salts this is exemplified, for, if the muriate of soda from which they derive their bitter taste taste be taken away, their action on the alimentary canal is changed.

Paris's Pharmacologia.

Effects of opium combined.

Most men of experience agree, that when combined with some saline medicine, opium seldom causes that disturbance in the system, as headach and mental irritability, which is so common an effect of opium or laudanum, when taken singly. Hence the reputation of the Dover's powder, and of the modes of combining laudanum with the citrate of potass, the sulphate of magnesia, or with ammonia, all which combinations are extremely useful when administering opium in disorders of the heart.

Crude opium, combined with *calomel,* is another formula, from which most beneficial effects are produced in some disorders of the heart, especially in all those wherein the specific effects of mercury upon the system are desirable, such as in its inflammatory affections, and when it is thought advisable to give opium in sufficient doses to alleviate pain. In other cases I am in the practice of giving the few first doses of opium combined with calomel, and afterwards giving it singly or combined with the antimonial powder, or James's powder when it is desirable to prevent any mercurial affection of the system. The combination of opium with *antimony*, such as the antimonial, and more especially with James's powder, is a most useful formula.

Effects of digitalis.

The effects of *digitalis* on the circulation are so powerful, that it has been called the "opium of the heart." At the same time the influence of this medicine and of opium on the heart is quite different, and each is applicable to different conditions of the central organ of the circulation. In all inflammatory affections, after depletive measures have been employed, the irritable state of the heart is generally relieved by opium, but *digitalis*, like antimony, has so decided an effect in diminishing the heart's action far below the natural standard,* that in those maladies where its vigour is already greatly diminished, digitalis must be administered with great caution, its effects being in such cases to diminish still further the nervous energy. The hurtful effects of digitalis are remarkable in all cases of atrophy and dilitation of the walls of the pulmonic heart, and where there is great prostration of strength, and in those cases where the aortic valves are diseased, and the blood regurgitating into the ventricle, a greater rather than a diminished power will be necessary for the ventricle to carry on the circulation, so that in such cases digitalis will be injurious. But in those diseases where the action of the heart is increased, and where the propriety of diminishing it is indicated, then digitalis often produces the best effects, the subdued action of the heart which follows its exhibition diminishing the force of the vital stream in the thoracic viscera.

Besides its *neurotic* powers, digitalis, taken singly, or combined with a mercurial, is a powerful *diuretic*, promoting the action of the absorbents and increasing the secretion of urine; and hence its utility in removing effusions in the pericardium.

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* A case is recorded by Barth and Roger in which the pulse was reduced to twenty-five beats in a minute by digitalis.

Along with the advantages of selecting appropriate cases of affections of the heart for its exhibition, *digitalis* is one of those medicinal substances, the action of which is very uncertain. It frequently excites nausea, and even vomiting, irritates the mucous membrane of the alimentary canal, and, in place of diminishing, it increases the heart's action. It is also one of those medicines such as colchicum, whose effects are sometimes *cumulative;* and examples are recorded where repeated doses of these medicines having been administered without any sensible influence, until so large a quantity has been ultimately given, that when they began severely to affect the system their action has been so violent as to destroy the patient.

All the good effects of digitalis, as of many other medicinal bodies, is usually obtained by giving it in small doses, these being readily absorbed, when a larger quantity passes through the alimentary canal, and produces comparatively little effect. Half a grain of the powder, five drops of the tincture, or half an ounce of the infusion of digitalis, repeated every twelve, eight, or six hours, will generally be found sufficient in those cases of disordered circulation where its exhibition is appropriate; and when there is effusion in the pericardium, then a small dose of the powder, combined with one or two grains of the common mercurial pill, and one of the squill pill, frequently repeated, and continued for some time, acts in many cases as a most powerful absorbent and diuretic. Digitalis may also be absorbed by the skin, and, where its exhibition is required, it has been recommended to apply a few grains of the powder upon a newly blistered surface.

Bouilleaud.

Effects of belladonna.

The influence of *belladonna* on the nerves of the iris, as well as its impression upon other portions of the nervous system, affords a very remarkable illustration of that great therapeutic law whereby the effects of medicinal molecules are confined to particular portions of the cerebro-spinal system. On the action of the heart the influence of belladonna is likewise very powerful, and although it has not been so much employed as some other *neurotics* in the treatment of diseases of the circulation, yet there are certain cases wherein its beneficial influence has been most decided. "A young lady, after a severe mental affliction, had a violent affection of the heart, the peculiar features of which were paroxysms of syncope accompanied with convulsions, and after a variety of remedies had been tried in vain, she experienced a most extraordinary relief from the external application of belladonna. When the extract in solution was applied to the nape of the neck it mitigated the symptoms almost immediately, and she ultimately became so expert in using it, that she knew the precise quantity to apply, and whenever the requisite influence of the medicine was produced she made a sign with her finger to her attendant to discontinue the application, being unable to speak. In this way she continued to suffer several years, and always received the usual relief from the belladonna."

Case communicated by Mr. Glen.

Like other neurotics, *hyoscyamus* influences some particular portions of the cerebro-spinal system, and in the same manner as belladonna makes its impression upon the iris, so the hyoscyamus, when given in certain doses, disturbs the functions of the *retina*, causing various imperfections in vision.

Its influence upon the nervous system generally has been considered analogous to *opium*, whilst it has the superiority to opium in seldom causing head-ache, and in not confining the bowels. But in disturbances of the heart, it has never appeared to me to possess the advantages of opium, nor has it, as far as I have been able to perceive, a specific effect on the *cardiac* nerves to recommend its use in any particular disorders of the heart.

Effects of tobacco.

Amongst neurotic plants there are others, besides opium, belladonna, and hyoscyamus, as tobacco, colchicum, and the nux vomica, which are composed of several different elements, each of which, when employed separately, acts upon a different portion of the nervous system.

Brodie, Ph Tr.

This has been distinctly ascertained with regard to *tobacco*, one of its ingredients, the *nicotine*, acting upon the nervous system, and another, its *essential oil*, acting upon the heart; and thus it can be satisfactorily explained how those who chew tobacco have their nervous system influenced by it, the saliva becoming impregnated with the *nicotine*; and how those who smoke have the heart disturbed from the essential oil which is evolved in the combustion.

Thompson's Mat. Med.

How far the powerful impression which the essential oil of tobacco makes upon the heart may be employed to alleviate any of its diseases, I have had no opportunity to ascertain.

These effects of some neurotics illustrate what seems to be another important therapeutic law, viz.,—that medicinal substances not only act upon particular systems of the animal œconomy, and that different effects are produced by different doses of them, but that some medicines contain several distinct elements, each of which act upon separate systems and portions of a system; and the practical lesson which this law gives, is, that we should employ the elements of such medicines either separately or combined, according to the particular system of the œconomy upon which their remedial properties are required. There may also be observed another striking analogy in addition to that formerly mentioned of the action of medicinal bodies upon the œconomy with the phenomena of disease; for as diseases commence in one system or tissue of an organ, and extend according to their violence and duration to other systems and to other tissues, so it is with medicines, these making their impression successively upon one system after another, or upon one tissue of an organ after another, according to the dose in which they may have been administered.

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Effects of Colchicum.

Besides the action of *colchicum* on the nervous system, and its influence upon the heart, it has also a powerful effect on the mucous coat of the alimentary canal, on the skin, and on the kidneys, so that when it is employed in the treatment of diseases of the heart, whether singly or combined, it acts not only as a *neurotic*, but it increases the mucous secretions of the intestines, the excretion of urine, and perspiration; and these multiplied effects of *colchicum* explain the benefit which is derived from its administration in some of those cases of disordered circulation in which the digestive apparatus, and the vital fluid itself, are variously deranged,—such as in gout and rheumatism, in both which diseases the action of the heart is generally so much disturbed.

In those maladies where colchicum is to be employed, whether in the form of wine, of tincture, of an extract, of the acetate, or of the powdered root, its effects are greatly modified, and more beneficial results obtained when these preparations are combined with magnesia, or with a neutral salt, as the sulphate of magnesia, the acetate of ammonia, and the citrate of potass.

Scudamore. on gout and rheumatism.

From five to ten drops of the colchicum wine given along with three drachms of the sulphate, and half a drachm of the carbonate of magnesia dissolved in a bitter infusion or in peppermint-water, is a most excellent formula; and in those small doses it has usually a very decided effect, and answers most purposes for which colchicum may be required in the treatment of diseases of the heart. Large doses of this medicine, and doses frequently repeated, are often very injurious, and their evil effects in *gout* seem to be produced from the derangement which they create in the circulation, as well as in the organs of excretion.

Effects of strychnia.

Besides those vegetable neurotics that have been mentioned, I may briefly allude to the influence of the *nux vomica*, as this violent medicine acts not only upon the nervous system in a very peculiar manner, but likewise on the organs of circulation. The powerful action of *strychnia* on the *motor* column of the spinal chord, is a remarkable illustration of the effects of particular medicinal bodies on particular portions of the cerebro-spinal system; and, as has been observed, in the same manner as we have diseases of particular portions of that system, so we have medicinal substances to remedy them, of which the curative effects of *strychnia* in the paraplegia caused by lead is a striking example. Of any curative virtues which strychnia may possess in diseases of the heart, I have no experience; but it is by no means improbable, that from the extensive manner in which it was employed by the earlier physicians in the treatment of insanity, epilepsy, and other nervous diseases, its reputation arose from its action upon the heart.

Effects of camphor.

There is no more valuable *neurotic* medicine employed in the treatment of some disturbances of the heart than *camphor*. When received into the stomach, it causes an immediate impression upon the gastric nerves, which afterwards extends over the whole nervous system. The power which camphor possesses in tranquillizing inordinate actions of the heart, has led to its being employed as a *soporific*; and in nervous palpitation, and in that irritable state of the heart which so often succeeds depletion, camphor may be had recourse to as a powerful *antispasmodic*.

Combined with opium, ammonia, or valerian, camphor is a useful adjunct in those cases where the use of these medicines is indicated.

Effects of ammonia.

Besides the impression which the carbonate of *ammonia* makes upon the gastric nerves, and which is afterwards communicated to the nervous centre immediately after it is received into the stomach, it also has a very decided influence upon the heart, and is perhaps the most powerful medicinal body that we possess for restoring the action of the heart when that has become feeble, and cause syncope.

Effects of ether.

Ether is also a powerful neurotic, and its effects as an *anæsthetic* agent have brought it into much repute; for although its influence on the organs of circulation, as well as on the nervous system, has long been established, yet its great virtue of destroying the sensibility of the *sensory column* of the spinal chord, and the practical application of that quality to allay pain, has only been of late years appreciated. Besides its extraordinary narcotic powers, ether is a powerful *antispasmodic* and *sedative*, and as such, is a valuable remedy in some disorders of the heart.

and of chloroform.

The effects of *chloroform* on the nervous system are very similar to those of ether, not only destroying the sensibility of the sensory column of the spinal chord, but acting as a *soporific* by its influence in tranquillizing the heart. For this purpose eight or ten drops of chloroform, rubbed together with two drachms of the mucilage of gum-arabic, prevents its evaporation, and is a sufficient dose to promote sleep. Like other powerful medicines of the same class, great caution is requisite in its administration, when there is any change in the heart's structure; and in the fatal cases which are recorded where it had been resorted to in order to allay the pain of an operation, death was occasioned by the interruption which the chloroform had caused to the circulation of the blood within a heart whose functions and structure had been previously changed.

The effects of *alcohol* in restoring the heart's action during a fit of syncope, and the instantaneous impression which it makes whenever it enters the stomach, is a proof of its powers upon the cardiac nerves; and that influence is prolonged after it is absorbed and conveyed to the blood.

Effects of prussic acid

The *hydrocyanic acid* is remarkable for its effects in diminishing the sensibility of the nervous system, and without destroying the circulation; for when life is instantaneously and completely extinguished by prussic aid, the heart is seen palpitating.

Majendie.

Hydrocyanic acid is universally acknowledged to be one of those neurotics which, however violent may be its effect when given even in a small quantity, yet it may with proper caution be usefully administered. From two to five drops of the diluted acid is a powerful remedy in some disorders of the heart. As a *soporific*, it may be often used advantageously in those persons whose heart is irritable, and in whom its beatings are so violent as to be felt when in bed. There are other disorders of the circulation where it acts as an *antispasmodic;* and in those coughs and embarassments in respiration where it has been found beneficial, the good effects have, in all probability, arisen from its influence on the circulation, which in such cases had been deranged.

Granville's Treatise on Prussic Acid.

Differences of alimentary and medicinal substances.

In concluding these therapeutic observations, I may briefly remark that, although all the neurotic medicinal substances produce effects on the animal œconomy in many respects analogous, yet in others their influence materially differs; and it is only by experience that we can learn how and under what circumstances each should be employed as a remedial agent in the maladies of the heart.

And, too, I may here observe, that no line of demarcation can be distinctly drawn between *alimentary* and *medicinal* substances: such a division must be considered as merely arbitrary. The same instinct which guides animals in the selection of their food, also impels them to eat substances which *we* denominate medicinal. We consider the bitter extractive, the muriate of soda and acid vegetables, to have medicinal properties; and yet animals partake of them at times along with, or as part of their aliment; and indeed what is a poison to one race is absolutely the food of another.

The tissues composed of the elements of medicines.

Chemical science having revealed that the elements of the animal are all to be found in the vegetable and mineral kingdom, and having also shown that particular substances contain the same elements as particular animal compounds, is it not therefore probable that the substances used as medicines produce special effects upon particular organs, and that, when conveyed into the system, they assimilate and combine each with some particular animal tissue? This inquiry opens a most interesting field of research; and its success will assist the pathologist in selecting the medicinal agent he should employ according to the tissue which is diseased.

To me this appears to be a legitimate induction from what is already known of the formation of animal substances. It is perfectly well understood, in feeding animals, that different kinds of food are employed according as it is desirable to accumulate *fat* or *muscle*. Cattle are fattened by feeding them upon those vegetables that contain the largest proportion of *starch* and *sugar*; and the muscle of the horse is increased by feeding him upon those grains, as oats, which contain the largest proportions of the *phosphate of lime*; for it is the starch and the sugar that contain the elements of fat, and the phosphate of lime is the essential ingredient of muscle; and recent chemical investigations have shown that opium contains elements which are identical with the cerebral pulp. These observations accord with what I formerly noticed when alluding to the mutual dependence which animals and vegetables have upon one another, animals living upon vegetables, and the excrementitious matter of animals becoming the food of plants.

Liebig.

See page 295.

The *cutaneous nerves* are a most important channel for the administration of neurotics; for besides the application of medicinal substances upon the surface of the skin, there are remedial means of a physical character which can be employed to influence the cerebro-spinal system by their operation on the cutaneous nerves.

All those medicinal bodies which act upon the nervous system, when received into the stomach, produce analogous effects when they are applied to the cutaneous surface; and in the treatment of the diseases of the heart, much benefit is often obtained by applying them on the cardiac region in the form of plasters and embrocations; for besides their local effects, it happens not unfrequently, that the medicine which deranges the digestive organs when received into the stomach, produces the best effects when applied on the integuments of the chest.

Those physical remedies which act upon the cutaneous nerves, are *friction*, *percussion*, *titillation*, *electricity*, and *acupuncturation*.

Effects of friction.

The influence of *friction* and percussion on the cutaneous nerves in exciting the circulation, is a custom very generally adopted, and is a valuable practice in those whose capillary circulation is languid; and we may observe its curative influence in many neuralgic diseases, and especially in some kinds of rheumatism. "When Captain Cook arrived at one of the Friendly Islands, he was seized with rheumatism, which was attended with acute pain; but he was soon relieved by gentle friction, a treatment which the islanders usually employed."

Effects of titillation.

Still more powerful is the influence of *titillation* in producing changes in the circulation. When carried beyond a pleasurable sensation, it causes *laughter*, a convulsive movement which marks a change in the condition of the heart, and which may become so violent as not only to cause pain in the cardiac region, more or less severe, but to bring on a complete convulsive paroxysm. How far *titillation* might be employed for the treatment of disorders of the heart, I am unable to say, though it seems extremely probable that it may be a means of remedying some derangements in the circulation.

Effects of galvanism.

The cutaneous nerves are a channel for the employment of *electricity* as a curative means in some disorders of the heart, and the *magnet* has been strongly recommended by Laennec for the treatment of its neuralgic affections.

Case communicated by Mr. Paxon.

"A young lady, who had been eagerly employed for several weeks with a difficult musical composition, was suddenly seized with what appeared to be a fit of common hysteria, but which terminated in a total loss of consciousness. Having submitted to many different kinds of treatment for upwards of ten months, her case was considered hopeless. She at this time had the appearance of a breathing statue rather than a living being,—tall and delicately formed, the eyes closed, the extremities cold, the pulse slow and moderately full, respiration natural, the muscles rigid; the extremities would remain for a considerable time in whatever position they were placed. She ate and drank with an apparent appetite, but without opening her eye-lids. She had occasionally an involuntary discharge of urine and fæces. The pupils were always permanently dilated, and not influenced by the strong light. She bore pricking with a needle and pinching without giving any evidence of suffering pain; and in no instance was there any appearance of her suffering, except when she was submitting to a course of electricity which was at this period of her illness resorted to as a forlorn hope. She was eleven months in this extraordinary state when I commenced the electric treatment, causing a current to pass along the spine from the occiput to the sacrum, then along the extremities, and lastly through the brain. During the first fortnight of the treatment there appeared but little change, excepting a restlessness not observed before. The use of the magneto-electrical machine was discontinued from the evident pain it produced. I then employed only frictional electricity, and after twenty-five applications of it her family were astonished, hearing her say in a most doleful tone, that she was better. From this moment, after nearly twelve months' silence, she progressively recovered by the electrical treatment."

Acupuncturation is another remedial measure, which has undoubtedly a great influence upon the nervous system, and has a decided effect in relieving some neuralgic diseases; but how far the effect of this operation on the cerebro-spinal system may prove beneficial in diseases of the heart, by its influence upon the cardiac nerves, I have had no experience to enable me to form an opinion.

Effects of temperature.

The same remedies which act upon the heart through the medium of the skin, exert their influence not only upon the cutaneous nerves, but as has been pointed out, on the cutaneous capillary system; and whatever may be the effects of warm and cold bathing, of the vapour, and of the shower bath, on the capillaries, there is doubtless a great impression made by the sudden application of cold or heat on the action of the heart, from the effects they produce on the cutaneous nerves. Thus the application of *heat* and *cold* upon the cutaneous surface become useful therapeutic agents in disorders of the circulation.

The changes which take place in the functions of the heart from the application of cold and heat upon the skin, as upon the gastro-pulmonary mucous surfaces, explains the curative effects which are derived from cold and warm bathing, from refrigerants, and rubefacients, and from protecting the cutaneous surface. The impression made by cold and heat applied to the skin seems, from the sudden shock which they occasion, to be first made upon the cutaneous nerves, and immediately afterwards changes are observed in the capillaries; or the impressions upon both these systems may be simultaneous, so that in whatever mode the action of cold and heat be explained, as remedial agents, they must be considered to have an influence upon both the cutaneous nerves and capillaries, and through both these channels to influence the functions of the heart.

The use of the warm bath, as indeed, of all other kinds of bathing, especially in disorders of the heart, requires much discrimination, not only as to the particular disease, and to the condition of the patient, but as regards the temperature, the length of time proper to remain in the water, the time of the day when it should be used; all which modify its effects upon the body. "The patient that bathes should keep himself still and quiet in his place, without speaking, and let those be doing that bathe him, either by throwing water over the head, or by wiping him dry. That the patient take care beforehand not to catch cold; that he does not bathe himself after eating or drinking, and that he abstain also from eating and drinking after coming out of the bath. That regard ought to be had whether the patient has accustomed himself to bathe in his health, and whether it did him good or hurt; that he abstain from bathing when the body is too open or too confined, or if they have not discharged before, or are too weak; if they have inclination to vomit, or a great loss of appetite; or that they bleed at the nose."

Hippocrates.

Now these rules, which have been handed down to us by the father of medicine, are applicable to all kinds of bathing, and it is not very unusual to hear of persons with a disorder of the heart who, from not adopting such precautions, have greatly increased their sufferings.

See page 246.

Unctuous matters applied to the skin is another therapeutic agent, employed either to prevent the imbibition of substances through the *epidermis*, or to be the channel of conveying medicinal substances to the cutaneous nerves and absorbents. They certainly prevent the epidermis from imbibing noxious matters, as we observe by the effects of anointing the hands before dissecting a dead body; for they are not only thus prevented from being contaminated with the odour, but there is no absorption of any of the decomposed animal matter. This effect of oiling the skin is also exemplified in the comparative small proportion of butchers, and those who are employed in making use of oily substances, which are affected by cholera and contagious diseases.

The cutaneous surface, with its nerves, its capillaries, and its absorbents, is *protected* from the immediate contact of solid substances, and from the atmosphere, by the *epidermis* and the oleaginous secretion of the *sebaceous* glands; and in disease, when these natural coverings do not afford sufficient protection to the integument, benefit is derived from covering the skin, or that portion of it adjacent to the diseased organ, with oiled silk, or by a plaster, which may act both by its non-conducting powers of heat, and also by the medicinal substances with which it may be compounded. The good effects of plasters are daily exemplified in relieving uneasy sensations, and even pain in the region of the chest.

Absorbents.—Having reviewed those medicinal substances which assist the process of digestion, and in which the absorbents of the digestive organs lend an essential aid, those remedial means which act upon the cutaneous and pulmonary absorbents next claim consideration. *Absorbents,* it may be noticed, is a term which has two distinct significations; those substances which act chemically, such as chalk, upon fluids in the alimentary canal, or upon the puriform discharge of an ulcerated surface, have been denominated absorbents, in works on the Materia Medica; whilst those medicines which increase or diminish the action of the lymphatic system, have also been called absorbents, and in this signification is the term here employed.

The absorbent system of vessels performs an essential function in the animal œconomy, conveying to the blood the *incrementitious* products prepared in the digestive canal, and also those substances which are imbibed by the lungs and by the skin; so that any irregularity in the supply of these incretions must more or less change the qualities of the blood, and therefore the manner in which the absorbent vessels perform their functions must modify the action of the heart.

Whenever it is desirable to increase the action of the absorbents, and this is frequently the case when, during or after inflammatory affections of the heart there has been some sero-albuminous effusion within the pericardium, or on the surface of the endocardium, there are medicinal substances by which the absorption can be increased. Of these the most powerful are *mercury* and *iodine;* and the curative effects of these medicines is the same whether they be taken into the stomach, applied to the skin, or inhaled by the lungs.

Derivatives.—Having endeavoured to give a general view of those medicinal substances which influence the excrementitious and the incrementitious processes, and the nervous system, and their curative effects in the diseases of the heart, there yet remains another class of remedies that here merit consideration.

The metastasis of diseases.

One of the most constant effects of a disordered circulation is an *irregularity* in the supply of the vital fluid to the different parts of the body, in some organs the natural quantity being increased, and in others diminished, to a corresponding degree. The important physiological fact, that for the due performance of the various functions changes in the supply of blood to the different organs are constantly taking place, according as more or less blood may be required for carrying on their functions, and the beautiful contrivances employed for thus regulating the circulation have been fully pointed out. But in disease, and when changes in the supply of blood have no longer a salutary influence on the various organs, it then becomes an important therapeutic point to determine when to apply such remedies as will assist in regulating the quantity of blood to the different organs.

See page 18.

The translation, or *metastasis*, of disease, affords another example of a curative process employed by the animal œconomy which we have the means of imitating, and by which we can remedy the pernicious effects of a disease by removing it from a vital to a less important organ. This remarkable pathological phenomenon has ever been considered a valuable curative indication; for whenever nature *translates* a disease from a vital to a less important part of the body, it seems to be one of those beneficent laws of the œconomy which we should always assist and endeavour to imitate.

Curative effects of derivatives.

It often happens, that in *arthritic* and *rheumatic* affections of the heart this process is resorted to by the œconomy, the symptoms being, in many instances, immediately alleviated by an arthritic or rheumatic inflammation suddenly affecting one or more of the joints of the extremities. In like manner, *eruptive* diseases and *abscesses* make their appearance in many instances to relieve internal diseases.

Case of George IV.

We observe the same pathological phenomena when the body has received a *wound* or injury, the injured part soon participating in the particular condition of the system at the time when the injury was received. The cautious surgeon takes advantage of this in recommending operations, always avoiding them when there is any tendency to a paroxysm of *gout*, and when they become urgent making use of sinapisms and blisters on distant parts in order, by the counter-irritation which these create, to prevent the gout being *translated* to the wounded part. It was from a want of this precaution that George the Fourth's life was in jeopardy, a tumour having been removed from the scalp whilst he was suffering from gouty inflammation of the knee. The gouty inflammation was translated from the left knee to the integuments of the head a few hours after the operation, and serious apprehensions were entertained of the result, until in a few hours the knee, fortunately, became inflamed, and at the same time the arthritic inflammation completely disappeared from the head.

Derivatives enumerated.

Derivatives is a valuable class of remedies in the treatment of diseases of the heart; and, as I shall point out in a subsequent part of this work, that the inflammatory affections of the heart are almost universally of a gouty or rheumatic character, we are enabled by derivatives to translate such maladies from the heart to less important parts.

This curative process performed by derivatives may be accomplished by remedies applied either to the cutaneous surface, or to its subjacent cellular tissue. By the application of *rubefacients* on the extremities such as mustard, turpentine, or cantharides, we increase the action of the cutaneous capillaries, and we endeavour to imitate nature's curative efforts by *vessication*, *pustulation*, and by creating inflammation and *suppuration* in the subcutaneous cellular tissue by *setons* and *issues;* and also by the *cautery* and *moxa*, remedies which were familiar to Hippocrates.

Effects of medicines from continuity.

Besides the observations that have been made on the different manner in which medicinal substances act upon the body, I may briefly allude to another mode by which some cutaneous medicines appear to produce their peculiar effects. I allude to that that action of medicines which is produced by the *continuity* of organs, for the medicine which is applied to one part of the body does not always limit its action to that superficies which it covers, but extends its influence to the tissues which are underneath it, and likewise to the organs which may be deeply situated. These effects are produced by a common poultice when it is applied to the integument covering a diseased liver or kidney; hence the effects from the contiguity of warm drinks on diseased lungs when passing down the æsophagus or entering the stomach, and likewise the use of cutaneous remedies applied to the cardiac region in disorders of the heart. Now this *radiating* effect of a medicine bears a striking analogy to the radiation of diseases, for a disease which commences in a small lymphatic gland involves during its progress, sooner or later, the contiguous cellular and cutaneous tissues.

Barbier Mat. Med.

Recapitulation.

Having concluded these general observations on the remedies employed for the treatment of diseases of the heart, it may be expedient briefly to recapitulate the chief points that have been discussed.

1st. I have endeavoured to show that Nature is possessed of powers not only to regulate and preserve, but likewise to restore disturbances in the circulation. See page 299.

2nd. That these powers consist of certain instinctive processes performed by the animal economy. See page 289.

3rd. That we possess artificial means by which we can imitate these processes of the economy. See page 296.

disease, from the first functional disturbance, to the formation of morbid changes in any of the heart's tissues.

The distinctive characters of the two classes is sufficiently apparent by the examination of diseased parts after death; although in those organs which the naked eye can reach, changes during life become invisible after death. If a limb, where a sanguineous congestion which has been produced by the application of a ligature around it, be macerated in water, it loses every vestige of disease. Whereas, if an extremity which had suffered from inflammation be treated in the same manner, its form remains unchanged—a sero-albuminous fluid having been deposited in its tissues. And functional disorders of the heart, like those of other organs, such as the alimentary canal and skin, exhibit, on dissection, no vestige of disease; whereas, in the *organic* diseases, some morbid alterations are detected after death; although, at the same time, changes in the tissue that existed during life, may after death have completely disappeared.

The *functional* disorders of the heart, include those wherein there is a disturbance of the circulation, either from changes in the *quantity* of blood within the cavities of the heart; from an interruption to the *entrance*, or to the *exit* of the blood, or from changes in the *quality* of the blood. They arise likewise from vital causes, or from that *sympathy* which subsists between the heart and the other systems of the economy; and they may also be produced by changes in the functions of *both*, or of only *one* of the hearts.

Nosographie Philosophique.

Lessons Pathologique.

The *organic* diseases comprehend all those wherein there is an appreciable change in the structure of any of the heart's component tissues; an arrangement formed according to those physiological principles which were first adopted in classifying the organic diseases of other organs of the body by the ingenious Pinel and Bichât.

Besides being divided into those affecting particular tissues, I have subdivided the organic diseases of the heart into the *idiopathic* and the *specific*, and into those of the *systemic* and of the *pulmonic* heart; for diseases are not only limited to one tissue, but they are also limited to one, and seldom affect both hearts. Diseases cannot be legitimately divided into the *acute* and *chronic*; these terms signifying merely different stages of the same malady.

The following *table* must be considered as an outline of a detailed classification of the diseases of the heart.

TABLE OF THE DISEASES OF THE HEART.

FUNCTIONAL DISEASES.

- Blood changed in
  - Quantities.
    - Congestion
    - Syncope
    - Anemia
      - Cardiac Congestion.
      - Systemic Congestion.
      - Pulmonic Congestion.
      - Coronary Congestion.
      - Pulmo-cardiac Congestion.
  - Qualities.
    - Palpitation from
      - Chlorosis.
      - Jaundice.
      - Morbus Cærulius.
- Sympathetic affections from
  - Cerebro-spinal Irritation.
  - Digestive Irritation.
  - Uterine Irritation.
  - Genito-urinary Irritation.
  - Cutaneous Irritation.
  - Angina.

ORGANIC DISEASES.

- Diseases of Different Tissues.
  - Sero-fibrous Tissues.
    - Pericardium.
      - Pericarditis . . . .
        - Ideopathic.
        - Arthritic.
        - Rheumatic.
        - Exanthematous.
      - Dropsy.
      - Puriform Effusions.
      - Ossification.
    - Endocardium.
      - Endocarditis . . . .
        - Ideopathic.
        - Arthritic.
        - Rheumatic.
        - Exanthematous.
      - Albuminous Effusion.
      - Ossification.
  - Muscular Tissue.
    - Atrophy.
    - Hypertrophy.
    - Softening.
    - Inflammation.
    - Abscess.
    - Fatty Degeneration.
  - Coronary Vessels.
    - Arteries.
      - Inflammation.
      - Ossification.
    - Veins.
      - Varix.
  - Adipose Tissue.
    - Morbid Depositions of Fat.
- Systemic Heart. / Pulmonic Heart. } Diseases of,
- Ideopathic and / Specific. } Diseases.
- Rupture and Lacerations.
- Aneurism.
- Malformations.

CHAPTER XXI.

ON THE CONGESTION OF THE HEART.

General observations on the heart's functional diseases; this subject neglected; its extent and importance; peculiarity of the heart's functional diseases; these are derived from the peculiarity of its natural functions; the phenomena, causes, symptoms and diagonosis of cardiac congestion; congestion of the coronary vessels; systemic and pulmonic congestion; pulmo-cardiac congestion; treatment of congestion.

General observations on functional diseases.

Before entering upon the subject of congestion, I may remark, as regards functional diseases of the heart in general, that in the works which have professedly treated of the diseases of this important organ, little notice has been taken, far less have any minute researches been made, into the nature of its *functional* disorders; and this is the more surprising, as such affections are both numerous and of frequent occurrence, and most of them are remediable by medical treatment. Indeed, there can be no more satisfactory evidence of the frequency of the heart's functional disorders, than the frequency in the changes of the arterial pulse,—these always indicating some corresponding change in the function of the heart.

But it is not on all occasions easy to draw a distinct line of line of demarcation between the natural and the diseased functions of any organ; for the same functions are performed both in health and in disease. A person vomits in order to empty the stomach of deleterious food; and he also vomits as an act of the economy, to assist in restoring the circulation during a fit of syncope. He respires to oxygenate the blood; and he breathes quickly to relieve a congested state of the thoracic viscera.

See page 77.

See page 80.

The morbid changes of the different tissues which compose the heart, present the same characters as those of similar tissues in other organs; but the disorders of the heart which are functional, are peculiar to the central organ of the circulation; for like other vital organs, the heart has its own particular functional diseases.

The circumstance of the heart being neither an organ of secretion nor of excretion, but merely a receptacle for receiving, its muscular parietes propelling the blood into the proper vessels, produces a particular assemblage of symptoms wherever its functions are deranged; and, besides, the circumstance of the heart's action being *unremitting* is a peculiarity in its function which must essentially modify its various diseases. See p. 11.

1.—*General Observations on Congestion of the Heart.*

Having fully explained, when considering "the phenomena and causes of the diseases of the heart in general," the nature of cardiac congestion, and the various phenomena with which it is accompanied, these observations will serve as an introduction to what now remains to be said on this important subject. See page 104.

It has already been observed, that the heart, in its natural and healthy condition, neither expels during each contraction the whole of its contents, nor does it receive during each dilatation, all the blood which its cavities could contain. See page 8.

It has been likewise shown, that differences in the *quantity* of the heart's blood are almost constantly taking place during the performance of the natural functions of the body; and that, in order to regulate the quantity of blood in the cavities of the heart, the economy itself possesses certain means. I have also endeavoured to point out that, when any superabundant blood cannot be removed from the heart by these instinctive processes which are possessed by the economy, the congestion then becomes permanent; a condition which is by far one of the most frequent causes of disorders of the heart; and a condition, too, which, in place of having been hitherto considered as a primary affection of the heart, or described as a distinct disease, has only been cursorily alluded to amongst the diseases either of the *pulmonary*, or of the *nervous* systems, some authors having considered it as belonging to the former class, because of the cough, dyspnœa, and hœmoptysis, by which it is usually accompanied; and others to the latter class, from its being attended by disturbances of one or more portions of the cerebro-spinal system.

Their imperfect classification.

Besides *cardiac* congestion, properly so called, there may also be a congestion of the *coronary*, or of the *pulmonary* vessels.

Coronary congestion.

I have said, that when the *cavities* of the heart become congested, a corresponding change must necessarily take place in the *coronary* vessels; for whenever there is any unusual increase in the quantity of blood in the left ventricle, from an increased velocity of the retrograde current of the aortic blood,—such as may be produced by a great muscular exertion,—the *coronary arteries* will then participate in this additional supply; and the right heart being at the same time overloaded from an increased influx of the venous blood, the momentum of the stream from the coronary *veins* will be proportionably diminished. The consequence of these changes in the circulation of the coronary arteries and veins, will be an increase in the quantity of blood in both systems of vessels; a condition, which, in order to distinguish it from congestion of the heart's cavities, may be appropriately denominated *coronary* congestion.

See page 116.

See diseases of the coronary vessels.

From the preceding remarks it appears that there can be no congestion in the heart without a corresponding over-distention of the *coronary* vessels; so that we are entitled to conclude that the changes in the heart's action, when it is in a state of congestion, are not only produced by an increase in the quantity of blood within its cavities, but also by an increased quantity in the coronary vessels. Thus we are enabled to explain the commencement of the symptoms of cardiac congestion,—their progress,—the changes of structure which is sometimes ultimately produced, and likewise the effects of that treatment which experience has found to be most efficacious; especially the benefit which is derived from *leeches* applied to the præcordial region in consequence of the vascular *anastomoses* of the coronary and mammary arteries. At the same time it must be taken into consideration, that whenever there is a congestion of the cavities of the heart, and a like condition of the coronary vessels, there must necessarily be an assemblage of symptoms, some of which will be referable to the congested auriculo-ventricular cavities, and others to the congested coronary arteries and veins.

Pulmo-cardiac congestion.

The intimate relation that subsists between the *lungs* and both the pulmonic and systemic heart, must, it is evident, cause any disturbance of the functions of the heart, materially to affect the *pulmonary* circulation; and in all those temporary changes in the quantity of the heart's blood which are constantly taking place, and which are quite compatible with health, the lungs perform as important a share as the heart itself, in preserving and in restoring the balance of the thoracic circulation. The sobbing and sighing, the deep inspirations, the screaming, the paroxysms of laughter, the convulsions and the vomiting, so frequently the effects of a hysteric paroxysm, I have fully explained, are all instinctive acts by which the lungs, conjointly with the heart, restore a deranged circulation. See page 172.

The same changes in the quantity of blood within the heart's cavities that increase its action, we have also seen, from an overdistention of the pulmonary vessels, and consequently the circumscribed distention of the air-cells, cause an increased frequency in respiration; and, for the same reason, when there is congestion to such a degree that the powers of the heart itself are not sufficient to relieve, and when the superabundant blood in the pulmonary vessels cannot be removed by any of those instinctive acts, or by modifications in respiration which are possessed by the economy, then respiration not only becomes permanently embarrassed, but, in extreme cases, there supervene dyspnœa, cough, pulmonary hæmorrhage, and even suffocation. Page 114.

Influence of congestion on the different systems.

Besides the condition of the pulmonary circulation when the cavities of the heart have become congested, various disturbances arise, in consequence of changes in the distribution of the blood in different systems of the economy; especially in the *cerebro-spinal*, in the *digestive*, and in the *capillary* systems.

As the reciprocal dependence and co-operation in the functions of the *brain* with those of the heart are such, that whatever disturbs the functions of one of these vital organs, must influence those of the other; so we find in cardiac congestion, that whilst a corresponding engorgement takes place in the pulmonary vessels, the quantity of blood in the *cerebro-spinal* system is diminished; or at least there is a diminution in the proportion of the arterial blood in that system.

The *digestive* organs also are sometimes affected in congestion of the heart. There is often a sensation of oppression and of nausea, and the act of vomiting occasionally takes place, being an effort of the *vis medicatrix* to unload the congested heart.

Changes in the cutaneous surface.

Congestion of the heart is always accompanied with changes in the circulation of the *cutaneous capillaries;* and in proportion as the thoracic viscera are over-distended, so there is a corresponding *diminution* of the blood in the cutaneous capillaries; and hence the face is pale, and the skin of the extremities is bloodless.

This condition of the cutaneous circulation in congestion of the heart, is admirably delineated by our immortal poet; and he has made the picture more striking, by contrasting the congested heart with the head congested from strangulation:

> "Oft have I seen a timely-parted ghost,
> Of ashy semblance, meagre, pale, and bloodless,
> Being *all descended to the labouring heart;*
> Who, in the conflict that it held with death,
> Attracts the same for aidance 'gainst the enemy;
> Which with the heart there cools, and ne'er returneth
> To blush and beautify the cheek again.
> But see, his face is black, and full of blood;
> His eyeballs further out than when he lived,
> Staring full ghastly like a strangled man;
> His hair uprear'd, his nostrils stretched with struggling;
> His hands abroad displayed, as one that gasp'd
> And tugg'd for life, and was by strength subdued.
> Look on the sheets, his hair, you see, is sticking;
> His well-proportion'd beard made rough and rugged;
> Like to the summer's corn by tempest lodg'd.
> It cannot be but he was murder'd here;
> The least of all these signs were probable."

Henry VI.

2.—*The Causes of Congestion of the Heart.*

THE heart may be said to become congested from several distinct and very different causes.

1st. It may be the effect of an inordinate muscular exertion.

2nd. It may arise from the application of cold or heat to the cutaneous or mucous surface of the body.

3rd. It may arise from suppressed evacuations.

4th. It may arise from vital causes which diminish the muscular power of the heart.

5th. It may arise from diseases in the heart's structure; and,

6th. It may arise from an obstruction of the pulmonary circulation.

Congestion Caused by Muscular Exertions.—Of these different causes, let us first consider that of *inordinate muscular exertions;* such being not only a frequent cause of congestion, but affording a satisfactory explanation of all the phenomena of congestion, physiological as well as pathological, and likewise enabling us to establish rational principles on which the treatment should be conducted.

It has already been explained how the movements of the heart are quickened by all kinds of bodily exercise, and its pulsations increased, both in frequency and in force, by any muscular exertion.

It has also been explained how every movement of the body has not only the effect of hastening the return of the venous blood to the pulmonic heart, but likewise the effect of retarding the exit of the arterial blood from the systemic heart; and that, consequently, from every muscular effort, the cavities of the heart become more or less distended with blood.

When, therefore, from an unusual muscular exertion, there is such an accumulation of blood or congestion in the thoracic viscera, that the person does not soon recover his natural tranquil and regular respiration, and there is a disturbance in the action of the heart, along with a hurried respiration, as may be considered beyond the scale of health, such change conveys the notion of the most simple form of a morbid condition of that organ.

A disturbance in the action of the heart from muscular exertion, it may be anticipated, will vary, not only in degree, but in duration; in some cases being so slight as scarcely to arrest attention, and to be merely transitory; but in other instances it proceeds to such an extent, and is so long continued, as either to be immediately followed by, or to lay the foundation of some permanent mischief.

Indeed, when the heart and lungs have been congested to such a degree that they have not been relieved of all surplus blood, an increase in the impulse of the heart, and an embarrassment in respiration, may continue for any length of time; and in some instances, when the functions of the central organ have been much disturbed, the circulation is not perfectly performed, even throughout the remainder of life. Hence, patients with a disorder of the heart can often trace its commencement to an unusual muscular exertion, at some more or less distant period.

But it is those persons who are not accustomed to take severe exercise, and who are not in what is called "good wind," who are most exposed to injure the heart by making any unusual exertion. The condition of the thoracic viscera of a person who is properly "trained," I have already endeavoured to explain; and without a previous knowledge of the *pulmo-cardiac* function, and of certain peculiarities in the structure of the lungs, no rational explanation could have been given of the power which is acquired by some persons that enables them to perform various muscular movements; it being quite clear that the differences in the powers which different persons have for running, dancing, reading aloud, blowing wind-instruments, and the like, does not alone depend on differences in their muscular vigour. It is by modifications which they make in respiration, that they are enabled not only to execute muscular movements, which those who have not been "trained" cannot perform, but they are thus rendered less susceptible of those disorders of the heart to which others who are not in equal "condition" are so much exposed.

See page 71.

Different causes of congestion.

See page 114.

Those whose necessary avocations or whose amusements excite them to make a violent muscular exertion, such as in *running*, *dancing*, *rowing*, and in performing *feats of strength*, frequently suffer from congestion of the heart.

Congestion caused by running.

Cases.

There is no more frequent cause of congestion than for a person to *run* more quickly, or to a greater distance, than he is accustomed to. A man, whilst running to catch a coach, fell down senseless, but soon recovered. The same person, when running on a similar occasion, staggered and fell, and became very uneasy and unwell for twenty minutes afterwards. A young lady was induced to run up a hill, and she did not recover her natural breathing until some weeks after, when, finding the heart's action unnaturally vigorous, a few leeches were applied to the cardiac region, which, along with antimonials, restored the tranquillity of the circulation. A student at Eton was so excited with a pack of hounds passing by him in full chase, that he was induced to run after them, which caused such disturbance in the heart, that he died fifteen months afterwards from cardiac disease.

By dancing.

Public *dancers*, too, being frequently impelled to make extraordinary muscular effort, often suffer from congestion of the heart.

Case communicated by M. Albert.

"A highly accomplished 'danseuse,' after having been confined to her chamber by a temporary indisposition, and deprived during that time of her accustomed practice, was induced to make one evening a very great effort from the applause she met with at a crowded theatre. Her breathing became so much oppressed, and the heart beat so violently, that she was under the necessity of being assisted to her home. By great tranquillity these symptoms gradually abated, but she never afterwards recovered her breath completely, so that she was compelled to retire from the stage."

By gymnastics.

Case.

Similar affections of the heart are likewise brought on by an improper use of *gymnastic* exercises. A youth, who was a pupil at a school in Switzerland, where gymnastic exercises were practised to a very great extent, was sent home on account of a congestion of the heart, brought on by the violent muscular exertions he had been compelled to make.

By rowing.

Sailors, when exposed to excessive bodily exertion, in *rowing* a boat, and in situations of danger, often suffer from congestion of the heart; and there are instances of boatmen who, in rowing "matches," have suddenly expired. Of all amusements, *rowing* is the most frequent cause of a disordered heart; and this frequency no doubt arises from young men, particularly at our public schools and universities, being incited to make exertions, when rowing matches, beyond their strength, and especially when they had not undergone the requisite "training." A youth made the most violent efforts to win a great rowing match, in which he succeeded. The action of the heart was greatly disturbed, and for several years afterwards it remained in an irritable state.

Case.

Those whose avocations expose them to violent muscular exertions are also subject to similar ailments. A chambermaid, when carrying coals up-stairs, often became so breathless as to be obliged to sit down and rest herself, and it was usually some time before she could again begin to ascend the stairs with her burthen. After having suffered some weeks, she then applied to me, complaining of very considerable difficulty of breathing, with a great increase in the impulse of the heart. By applying a few leeches four times successively, and taking a dose of James's powder every night, she soon recovered.

Page 113.

But cardiac congestion, as I have already stated, sometimes proceeds to such an extent as to injure the heart's structures, and to cause even a rupture of its parietes, or of the trunks of the great vessels within the pericardium, when these have been previously diseased.

There is a change in the *lungs*, which has been observed in *animals* that have dropped down lifeless from cardiac congestion caused by extreme muscular exertion; but which, I am not aware, has been observed in the human body, though it may sometimes take place, and may account for a certain condition of the lungs of those persons, who, from some over-exertion, never after recover perfect breathing. The change alluded to, has been described by Sir Everard Home, and consists in lymph being effused into the air-cells; and I have found in animals that have died under similar circumstances, blood also effused immediately beneath the pulmonic pleura.

Phil. Trs. 1827.

Cardiac Congestion in animals.

This influence of inordinate muscular exertion in causing cardiac congestion is exemplified, as I have already mentioned, in a very striking manner in *animals;* and to this may be attributed diseases of the heart which are frequently to be observed in the horse, he being called on to perform great labour, and often compelled to make such violent muscular exertions, as cannot fail to produce a congested heart.

Congestion caused by Mental Emotions.—The influence of the mind upon the heart must have led the word *heart* to have been used in "Holy Writ," and in common language, as synonymous with the moral sentiments. The powerful influence which the different passions have on the heart, renders this language not merely figurative; for it is strictly true, that mental emotions, which cause only a temporary change in the heart's movements, if long continued or often repeated, frequently lay the foundation of permanent disease. Indeed, on reviewing cases of affections of the heart which have come within my own observation, it is remarkable in how many instances they could be distinctly traced to some sudden or violent mental excitement.

No diseases appear to me more worthy of diligent investigation than the class of affections of the heart to which I have now alluded; being convinced that many which ultimately destroy life owe their origin to a moral cause, and which might, as I shall endeavour to show, have been subdued by an early and judicious treatment. This powerful influence of the mind ought surely to be an useful lesson to medical men in the *moral* treatment of the sick, especially of those who have a disorder of the heart; and instances are daily to be met with, of persons suffering much mental disquietude, and of their diseases being greatly aggravated by receiving incautious opinions; and still more frequently by having been exposed to the empirical parade of a stethoscopical examination.

"If one doubted the fatal influence of the passions on the heart, it would be sufficient for him to know that it may be torn in fits of anger, and cause sudden death; and I am not the only person who considers that organic lesions were more frequent during the days of the Revolution, than during the ordinary tranquillity of social order." Corvisart.

When inquiring into the causes of the diseases of the heart in general, I remarked the differences in the effects produced by the *exciting* and by the *depressing* passions on the organs of circulation; the exciting emotions increasing the impulse and sounds of the heart, whilst the depressing passions diminish both its impulse and sounds. See page 121.

Congestion caused by the exciting and depressing passions.

If the impulse of the heart be increased by the *exciting* passions, this effect is produced by an additional quantity of blood being congested in the heart's cavities, in consequence of the violent muscular movements which the passion excites; whereas, in a congestion caused by the *depressing* passions, the action of the heart is diminished by the nervous influence, and the whole frame becomes motionless and prostrate. "Fear is characterised by feebleness throughout the whole vascular system, preventing the blood reaching the capillaries, and causing that general paleness, remarkable particularly in the face." Bichat.

Congestion of the heart from either of these causes, is met with in every possible degree; and I have already mentioned instances where sudden death has been caused by mental emotions;

See page 120. and when the passion has been so violent as to extinguish life, the death is, in one case, the effect of an increased circulation in the cerebro-spinal system, and, in the other, of congestion in the heart itself.

Congestion caused by laughter. Laughter, I have already endeavoured to show, is one of those acts which the economy employs to invigorate the heart; the phenomena by which it is accompanied affording an excellent illustration of the operations of the *musculo-cardiac* function— See page 77. the muscular movements during laughter increasing the quantity of the heart's blood. Indeed, it is by thus invigorating the circulation that we can explain how mirth and laughter are useful auxiliaries in promoting the digestion of food.

To preserve a healthy condition of the body, this influence of *laughter* is essentially useful; but laughter, when carried to excess, has effects which are equally hurtful, producing violent convulsions that are followed by such a degree of cardiac congestion as the *vis conservatrix* cannot overcome, and an engorgement of the heart, which may not only become permanent, but may even endanger life. The common expression of "fits of laughter," and of a person being "convulsed with laughter," are, therefore, pathologically correct, are links of one chain of phenomena, and are the effects of different degrees of congestion.

Case. A gentleman had, one evening, an immoderate fit of laughter, which lasted upwards of an hour. After the laughing ceased, it was succeeded by a violent *hiccup,* which continued during the whole night and the following morning. He then complained of a distressing sense of choking and oppression on the sternal part of the throat, besides the hiccup, with a strong impulse of the heart, and a sensation of fulness and tenderness on pressure. Four leeches were applied to the precordial region, which bled profusely, and after taking a few doses of the tartarite of antimony, he completely recovered.

and by bodily pain. Congestion is also caused in those who are suffering great *pain,* and who make an effort not to give it expression. By such an effort the economy is prevented from performing those acts of crying, screaming, weeping, and violent muscular movements, by which the arterial blood in the heart is increased; and the vigour of the heart has thus been often so greatly diminished, and the congestion caused by the pain such, that death has been the immediate consequence:

> "Give sorrow words; the Grief that does not speak,
> Whispers the o'er-fraught heart, and bids it break!"

Shakspeare.

Congestion from cold applied to the digestive canal.

Congestion, caused by Extreme Cold or Heat.—The sudden application of extreme cold to the *mucous* membrane of the stomach, by drinking very cold water, or eating "ice," more especially at a time when the body has been over-heated, is frequently the cause of cardiac congestion, and has been in many instances followed by serious consequences, in some having proved fatal. But even if the body has not been over-heated, eating "ice" often produces a most distressing pain in the region of the heart, and sometimes the disturbance caused in the circulation is followed by violent headache and even epistaxis.

The effects of *cold* on the circulation, whether it be applied to the cutaneous or to the gastro-pulmonary mucous surface, are equally remarkable; causing a diminution of blood in the cutaneous capillaries, and probably a similar effect on the mucous membranes of the intestines, along with a corresponding increase of blood in the vascular system of the interior of the body, more especially a congestion in the thoracic viscera.

When mentioning the influence of *cold* on the mucous membrane of the digestive canal, in causing disturbances of the heart, I made allusion to a case where its effects were suddenly fatal, merely from the introduction of a piece of ice into the rectum, in order to relieve hæmorrhoids; the sudden death being, in this case, doubtless caused by congestion of the heart, in like manner as those perish from the congestion which is caused by the exposure of the whole body to intense cold. A man of middle age, being very much heated from dancing, drank a tumbler of "iced water." Half an hour afterwards he experienced a sensation of numbness in the face, and a cold chill came on, which was followed by a profuse perspiration, palpitation at the heart, difficulty of breathing, noises in the ears, and a dimness of sight which in a few hours amounted to blindness. These feelings all abated during the night, but recurred suddenly in three days, and lasted a quarter of an hour. This person had similar attacks once or twice a week for two years.

Case.

Congestion from cold applied to the lungs.

Equally pernicious are the effects of suddenly breathing very cold air on the *pulmonary* mucous membrane; the heart, as well as the lungs, become thereby congested, this taking place before any *inflammatory* symptoms supervene.

The effects of cold on the mucous membrane of the lungs are no less remarkable than on the mucous membrane of the digestive canal. This influence we see exemplified by the almost instantaneous effects which breathing cold air has in causing general fever; and from the contiguity of the mucous membrane of the bronchi with the tissues which compose the lungs, there is often cough and other pulmonary symptoms.

When the heart is previously diseased, the effects of congestion from cold are often extremely dangerous. The pulmonary mucous membrane is, in such cases, very susceptible of inflammation; so much so, that we seldom find the heart diseased without some accompanying redness of the lining of the bronchi. At other times the application of cold increases the derangement of a heart that has been previously disordered.

Congestion from cold applied to the cutaneous surface.

The effects of exposure to cold upon the *cutaneous* surface, are, in many respects, analogous to those which cold produces on the gastro-pulmonary mucous membrane.

Congestion is not unfrequently caused by *cold bathing;* especially in those who are suffering from a disturbed circulation; and, therefore, it is always proper to ascertain the condition of the heart before making use of the bath. A gentleman of a gouty diathesis had a painful sensation in the heart, which came on after bathing in the sea, and which continued for several months. The impulse of the heart was increased, and the arterial pulse was small, which disordered state of the circulation yielded to antimonials, and the uneasy sensations in the heart were also completely relieved.

Case.

Congestion caused by cold bathing sometimes proceeds so far as to check altogether the transit of the blood through the heart, and extinguish life. A gentleman was advised to bathe in the sea, and the moment that his legs were immersed in the cold water he fell down lifeless.

Case.

The influence of exposure of the body to severe cold, in diminishing the quantity of blood in the cutaneous surface, and congesting it in the internal viscera, is well known; and hence the benefit which those suffering from cold derive from keeping the limbs in motion, which by the influence of the *musculo-cardiac* function, accelerates the circulation of the blood. Such was the method recommended by Xenophon to the Greek troops, in the memorable "Retreat of the Ten Thousand."

It is by no means unusual to hear of persons who have suffered great indisposition from sleeping in a *cold* and *damp bed;* and instances are not very rare where the effects have even proved fatal; and I have already mentioned cases of this kind.

The first effects of sleeping in a damp bed are perceived upon the skin, deranging the functions of the cutaneous capillaries; and this derangement of the capillary system is accompanied with a corresponding change in the circulation of the whole sanguineous system. Besides the general chilliness and coldness of the cutaneous surface, there is much inequality in the heat of different parts of the skin, the natural temperature never being restored throughout the whole system at the same time; and this condition may continue, not only for days and weeks, but even for months after the exposure.

To these effects there succeeds a congested state of the heart, marked by an increased impetus in its movements, and a feebleness of the arterial pulse. In consequence of the congestion of the thoracic viscera, there often comes on cough of a spasmodic character; and in many cases, too, the pulmonary mucous surface is inflamed. There are also headache, giddiness, or uneasy sensations in the head, restlessness, and excessive debility of the whole muscular frame, local pains, and very frequently an attack either of muscular or articular rheumatism. At the same time considerable derangement of the digestive canal ensues, of which there is no more remarkable symptom than nausea, with a peculiar brownness, and an increase of the *bulk* of the tongue.

The body, protected from cold by the mind.

Here I may allude to the extraordinary power of the mind, which enables the body to resist cold by invigorating the heart; the same power which is so remarkable in enabling it to resist disease.

"In the expedition of the Russians to Khiva, notwithstanding the intensity of the cold, the soldiers, flushed with hope of victory, marched along singing, with the breast of their coats open.

But the same troops, after marching little more than twelve miles *at a very slow pace, to gratify* some whim of their commander, *suffered severely, one third of* them being attacked on the succeeding day with a fever, of which many died."

Sir G. Lefevre.

Extreme heat causes congestion.

Extreme heat, whether from hot substances being applied to the skin, or to the gastro-pulmonary mucous membrane, may also cause congestion of the heart; of which I have narrated two remarkable cases.

See page [illegible].

Congestion caused by poisons.

Many of the vegetable and mineral *poisons* produce their fatal effects from the heart becoming congested by their influence on the cardiac nerves, the muscular powers of the heart becoming so enfeebled as to render the central organ incapable of circulating the blood.

The inhalation of some *noxious gases* has likewise a powerful effect in causing a congestion of the heart, the condition of the heart being, in such cases, produced by chemical changes in the qualities of the blood, the noxious effects of which diminish the heart's vigour, and render it incapable of freely evacuating its contents.

Congestion from suppressed evacuations.—Congestion of the heart may be caused by the suppression of an habitual sanguineous evacuation, such as the menstrual or the hæmorrhoidal flux; by the sudden stoppage of the discharge of an old ulcer, or by an eruptive disease being quickly healed.

Congestion, caused from suppressed catamenia, &c.

Congestion may be caused either by suppressed or by imperfect *menstruation.* The consent between the heart and the uterine system I have already pointed out, and endeavoured to show that diseases of the heart often cause disturbances of the uterus, and that diseases of the uterus in their turn create disorders of the heart. Checking the puriform discharge of a chronic ulcer, or suddenly healing an eruption, have often produced serious effects on the economy, and have sometimes led to fatal consequences; such being produced by changes in the sanguineous system. Some authors have considered that "the retrocession of cutaneous diseases is a cause of diseases of the heart."

Testa and Kreysig.

When the *catamenia* are suppressed the whole sanguineous system appears more or less disturbed, and most of the effects are referable to a congested condition of the heart.

"The idiopathic cases of suppression of the menses seldom continue long without being attended with various symptoms or disorders in different parts of the body very commonly arising from the blood which should have passed by the uterus being determined more copiously into other parts, and very often with such force as to produce hæmorrhages in these." Cullen.

Congestion, caused by diseases of the lungs.

Hitherto we have been contemplating congestion as an *idiopathic* affection; but not only does the heart become gorged with blood from diseased changes in its own structure, but, likewise from those of other organs. Thus congestion accompanies many diseases of the pulmonary apparatus; and of these, one of the most frequent is what may with propriety be denominated *pulmo-cardiac* congestion: for although the slightest increase of the heart's blood is accompanied by an increase of blood in the pulmonary vessels, yet there is a class of cases where the circulation in the lungs is first changed, and the disturbance of the circulation in the heart is the effect of that change in the lungs.*

One of the most frequent causes of pulmo-cardiac congestion is inflammation of the pulmonary *mucous* membrane, the effects of which is to congest the pulmonary capillaries. I do not allude to the obstruction which is caused in the respiratory organs during the active stage of inflammation, but to that chronic inflamed condition of the mucous membrane which in many cases continues long after all febrile excitement has subsided.

In such cases the diseased condition of the mucous membrane must have an influence more or less considerable on the pulmonary circulation, and, when long continued, is accompanied with all the characters of pulmonary congestion; so that a person who at the commencement of his ailment has only the usual symptoms of inflammation of the mucous membrane of the bronchi, has sooner or later superadded pulmo-cardiac congestion; and I may repeat here, that in like manner, as congestion of the heart usually accompanies congestion in the pulmonary vessels, so congestion of the pulmonary vessels will be sooner or later accompanied with congestion of the heart.

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* "In the majority of cases of *diseased heart* it appears that the embarrassment of breathing arises entirely from the *accumulation* of *blood* in the *pulmonary* vessels, in consequence of the difficulty which it finds in re-entering the cavities of the heart, the natural organization of which is more or less injured."—*Corvisart*, p. 390.

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Congestion, from plethora.

Cardiac congestion may be caused not only by changes in the structure of the cavities of the heart, and by diseases of the lungs, but the heart participates in that state of the sanguineous system where the quantity of the mass of blood exceeds the natural standard. The congested state of the heart which accompanies *plethora* is of a very different character from an idiopathic congestion; and there is no better diagnostic symptom than the state of the cardiac and arterial pulse in the two disorders: for whilst, in cardiac congestion, the heart's impulse is increased and the arterial pulse diminished; in plethora, the vigour of both the cardiac and arterial pulse is increased.

Congestion, from an obstructed artery.

Another cause of cardiac congestion to which I may briefly allude, is when a large *arterial* trunk is *obstructed*,—as in the operations for the cure of aneurisms; and it is this state of congestion, and its consequences, when left unsubdued, to which the failure of that operation may, in most instances, be attributed.

3.—*The Symptoms and Diagnosis of Congestion of the Heart.*

The anatomical symptoms.

THE most characteristic *anatomical* symptoms of congestion from an excessive muscular exertion are, an *increase* in the impulse of the heart, and a *diminution* in the vigour of the arterial pulse.

The increase in the heart's *impulse* arises from the parietes of the heart being preternaturally excited by the increased quantity of blood contained in its cavities, and the diminution in the vigour of the arterial pulse is in consequence of the left ventricle being unable to expel the blood with its wonted force; a condition of the circulation which is of great practical importance to be understood, as it points out the propriety of examining, at the same time, both the cardiac and the arterial pulse, and thus be enabled to adopt those remedial means to restore the disordered circulation which attention to the arterial pulse alone could not have suggested.

This increase in the impulse is generally to such a degree as to be felt by the patient, the term *palpitation* being employed in common language to signify such increase in the beatings of the heart.

Sensibility increased.

Besides an increase in the impulse, there is, in many cases, an increased *sensibility*, and more or less tenderness of the heart's parietes; and there is frequently a sensation also of fulness; to relieve which the patient makes an effort, by deep inspirations, but which he cannot altogether remove by any change in his breathing.

When the action of the heart is violent, it often causes more or less elevation of the intercostal muscles:

> "Her bosom heaves
> With palpitations wild."

Thompson.

Signs on percussion.

Changes in the sounds.

The *resonance* becomes dull over a large space of the chest, and the *sounds* of a congested heart are in the ratio of its impulse; for in those cases where the impulse of the systemic heart is increased, the audible sound is diminished, and when the congestion chiefly affects the pulmonic heart, the impulse is diminished and the sound proportionately increased.

Symptoms of coronary congestion.

Congestion of the cavities of the heart, and a like condition of the *coronary vessels*, cannot take place separately; and such a state must necessarily be accompanied by an assemblage of symptoms, some of which will be referrable to the over-distended cavities, and others to the congested coronary vessels.

In attempting to discriminate the symptoms of diseases of the coronary vessels from those of other portions of the heart's structure, we are at once met with many difficulties. There will be no change of form which can be detected by our sense of sight or touch; neither is it probable that the currents of the blood in these vessels create any audible sounds,—or, at all events, that sounds could be sufficiently loud not to be masked by those of the much stronger currents of the blood passing through the heart's different cavities.

We must therefore look for other channels of information, before we can expect to reveal the diagnostic symptoms of the diseases of the coronary vessels. Of some of these we must be satisfied with negative evidence; such, for example, as the effects of particular modes of treatment in relieving particular symptoms, —symptoms which are legitimately referrable to certain changes in the functions of the coronary system.

Another, and perhaps a more satisfactory evidence of the probability of disease in these vessels, may be derived from analogy, diseases of the stomach, of the uterus, and of the urinary bladder, [illegible] in the alimentary canal, or in the genito-urinary organs, we never take into consideration either the quantity or the quality of what their cavities may contain; but we at once refer all the accompanying symptoms to changes in their vascular system. And it surely must be the same with the heart; and when it is attacked with arthritic or rheumatic inflammation, all the effects which these diseases produce cannot be derived from any change in the quantity of blood within the heart's cavities, but from changes in the coronary circulation.

The disturbances which take place in the heart, not only from the translation of diseases, but also from those affections which are so frequently caused by the suppression of periodical discharges, as well as many that are the effects both of moral and physical causes, ought, I am convinced, to be attributed to changes in the coronary circulation,—changes which, sooner or later, produce the various morbid alterations that are met with in the different tissues of the heart. And the influence of these diseases upon the heart is precisely the same as that with which we are all familiar in the cerebro-spinal system, a congested state of the cerebral vessels being a very frequent consequence of the sudden suppression of some habitual discharge; such as that from an ulcer, or from the disappearance of an eruption.

[illegible] *The physiological symptoms of congestion of the heart are derived from those alterations in the functions of the different systems of the economy caused by changes in the distribution of the blood.*

[illegible] *The symptoms of congestion caused by changes in the circulation of the cerebro-spinal system are of the highest consequence. Indeed, it is impossible to conceive any change to take place in the functions of the heart without causing some change in the circulation of the nervous system; for as that system has unusual means in order to be secured with a constant supply of the vital* fluid, so will it be equally liable to suffer from the heart's disorders; and, except where there is any change in the structure of the brain and spinal chord, all the diseases of the vascular system must be of a secondary nature, some *primary* disease existing in the heart itself.

A reeling or swimming in the head, a difficulty in balancing the body, occular spectra, ringing in the ears, and a temporary disorder of the intellectual functions, are the most remarkable cerebral symptoms of a congested heart. See page 157.

Congestion is also accompanied by disturbances in the circulation of the spinal chord, and either the *motor* or the *sensory* column may be affected; so that in one class of cases there is a change in the sensibility of the sensory nerves, and in another, convulsive movements of those muscles which are supplied by the motor nerves. See page 176.

But it often happens, when the heart is congested, that not only is the circulation in the brain and spinal chord disturbed, causing the various symptoms which have just been enumerated, but the cerebral circulation is so deranged that *hæmorrhage* takes place within the head, and hence the frequent occurrence of *cerebral apoplexy* from disease of the heart. See page 166.

The hæmorrhage within the head may arise either from the exudation of blood from one of the serous surfaces of the brain, from the choroid plexus, or it may be caused by a rupture of one or more of the vessels of the cerebral parenchyma; the comparative delicacy of the tunics of the cerebral arteries rendering them more liable than other arteries to rupture from disturbances in the circulation.

When cerebral apoplexy is the consequence of a disordered See page 168. heart, it has been already pointed out that one class of symptoms are caused by derangement in the functions of the systemic, and another by derangement in those of the pulmonic heart,—a division of the symptoms which may be distinctly seen by comparing different cases of apoplexy, the effects of cardiac congestion. In the brain, as in other organs, there must be a constant change in the comparative quantity of the two bloods; and according to these changes must the symptoms vary. If the pulmonic heart be congested, all the symptoms, such as the lethargy, See page 176. the embarrassed respiration, the varicose condition of the subcutaneous veins, and the slow and easily-compressed arterial pulse, point out the deranged state of the *venous* circulation. Whilst, on the other hand, when the *systemic* heart is congested, the symptoms are of an opposite character; the headache, vertigo, ringing in the ears, ocular spectra, mental irritability, insomnolency, flushed countenance, and vigorous pulse, all indicate a change in the *arterial* circulation.

But though we are able to refer some of these symptoms to the pulmonic, and others to the systemic heart, yet we cannot well conceive any considerable degree of congestion present in the one heart without some corresponding change in the other; and, therefore, the assemblage of the symptoms must be very different in the various phases of this disease.

Symptoms derived from the pulmonary system.

See page 61.

Of the physiological symptoms none are more remarkable than those derived from the *pulmonary* system; for, as has already been observed, whenever the cavities of the heart cannot empty themselves of any extra blood, such additional quantity becomes necessarily congested in the pulmonary vessels; and the provisions with which the economy is endowed for preserving the balance of the circulation in the thoracic viscera are to be considered most unerring symptoms in disturbances of the heart.

These instinctive acts are of two kinds; by the one the blood in the heart is *increased*, by the other the quantity is *diminished;* and, what is of equal value to our pathological inquiries, the different acts are each executed by different organs. In this way we can satisfactorily explain how one person cries, screams, laughs, hiccups, sneezes, vomits, and has all the voluntary muscles thrown into convulsive movements; such acts contributing to increase the heart's blood, and may, therefore, be considered *symptoms* of a diminished vigour of the heart; and how another person sighs, sobs, and weeps, by which acts the surplus blood in an overloaded heart is forced into the lungs; the deep inspirations, by expanding the lungs, facilitate the ingress of the venous blood into the pulmonary arteries, and also assist the flow of the oxygenated blood into the pulmonary veins, the pulmonary vessels, being capable of sufficient distention to receive the superabundant blood, retain it until it is expelled by respiration; and these phenomena appear to me to afford not only

See page 38.

important symptoms of cardiac congestion, but also incontrovertible evidence of the *pulmo-cardiac*,—in as much as the former order of phenomena confirm the truth of a *musculo-cardiac* function.

Dyspnœa and asthma.

Dyspnœa and asthma are also *symptoms* characteristic of *pulmo-cardiac* congestion. The breathing may become more or less frequent, the expirations made with more difficulty than the inspirations, and this disturbance in respiration varies at different times, sometimes coming in paroxysms, and readily produced by the slightest movements of the body.

These changes in respiration differ much from the difficulty in breathing, which is caused by an organic change in the lungs. The "panting for breath," the short inspirations and long expirations are remarkable in those suffering from a congested heart; but when a portion of the lungs is incapable of oxygenating the blood, respiration becomes quickened, both the inspirations and expirations being shortened; the first condition arising from the pulmonary capillaries being gorged with blood, thus rendering inspiration quicker than expiration; and the second, the portion of lung which is rendered useless causing respiration to be quickened so as to enable the sound portion of the lungs the more perfectly to oxygenate the blood.

Cough.

There is no more characteristic symptom of congestion than the *cough* with which it is often accompanied. It is loud, harsh, dry, and comes in violent paroxysms. In place of being dry, it is sometimes accompanied with mucous expectoration; and when the paroxysm is particularly severe, which is usually the case in the morning when rising out of bed, there comes on nausea and sometimes vomiting, the effect of which is to evacuate some pellucid and more or less glutinous fluid. The cough is often brought on by making even the slightest exertion, especially by a change of posture, as in lying down, or rising up, or by walking up-stairs; and paroxysms of coughing are also excited by changes in the temperature of the atmosphere.

Hemoptysis.

See page 194.

Pulmonary *hæmorrhage* is likewise a frequent symptom of a congested heart. Sometimes the effusion of blood takes place immediately after the cause which produced the congestion; and in other cases it is a subsequent symptom; the hæmorrhage being an effort of the system to relieve the thoracic vicera of superabundant blood. Such spontaneous hæmorrhage is very different in its character from that which takes place in consequence of ulceration of the pulmonary parenchyma. See page 196.

The hæmorrhage which accompanies *pulmo-cardiac* congestion is remarkable for the large quantity of blood which is sometimes evacuated, and from the relief of the symptoms which it affords; but the bleeding is not always so very profuse, in some cases only a few ounces being evacuated in each attack.

"The quantity of blood expectorated is often enormous. I have seen a young man bring up ten pounds in the space of forty-eight hours, and expire at the termination of this period. In less acute cases, I have seen about thirty pounds of blood passed in fifteen days." Laennec.

See page 194 It has already been noticed that hæmoptysis, though it has often been considered as a symptom of ulceration of the parenchyma of the lungs, is frequently the effect of pulmo-cardiac congestion; and although the state of the thoracic viscera in such cases had not been explained, nor the pathognomonic characters of ulceration and of congestion of the lungs ascertained, yet that two very distinct states of the thoracic viscera are accompanied by hæmoptysis has been long known to pathologists.

"It has been commonly supposed that an *hæmoptysis* was naturally, and almost necessarily, followed by an *ulcer* of the lungs, but I will presume to say, that, in general, this is a mistake; for there have been many instances of hæmoptysis occasioned by external violence, without being followed by an ulcer of the lungs; and there have been also many instances of hæmoptysis from an internal cause without any consequent ulceration. And this too has been the case, not only when hæmoptysis happened to young persons, and recurred for several times, but when it has often recurred during the course of a long life." Cullen.

There is, indeed, no more certain diagnostic symptom of pulmo-cardiac congestion than the comparative *quantity* of blood which is expectorated from congested lungs and from an ulcer; for, whilst in congestion the bleeding is generally very profuse, the hæmorrhage accompanying ulcerated lungs is, except in very far-advanced cases, generally small.

"A severe hæmorrhage almost always indicates the existence of sanguineous engorgement; but this indication is not sure; for, as we have seen, bronchial hæmorrhage sometimes yields a very abundant flow of blood." Laennec.

Congestion of the heart may not only be accompanied by pulmonary hæmorrhage, but also by *pulmonary apoplexy*. In this disease there is an exudation of blood into the air-cells of the lungs; and from its resemblance to the sanguineous exhalation which produces cerebral apoplexy, it was denominated by Laennec pulmonary apoplexy.

"This alteration consists in an induration equal to that of the most complete hepatization of the lung, but also, altogether different. It is always partial, and rarely occupies a large portion of the lung; its most ordinary extent is from one to four cubic inches. It is almost always very exactly circumscribed, and, at the point where the induration ceases, the engorgement is as considerable as towards the centre. The pulmonary texture around is quite sound. We sometimes see two or three similar engorgements in the same lung, and as often both lungs are affected at the same time in the same manner. These engorgements are generally towards the centre of the inferior lobes, or towards the posterior thin part of the lung." Laennec.

"The principal *symptoms* of this disease are great oppression, accompanied with much irritation of the larynx, and sometimes with acute pain in the chest; a frequent pulse, voluminous, and presenting a peculiar sort of vibration, even when it is soft and feeble; and this takes place often at the end of a few days. There is seldom true fever, and the heat of the skin is natural, or nearly so. Often the heart and principal arteries give a very marked hollow sound." Laennec.

The symptoms of cardiac congestion caused by *cold* are of the same general character as those from inordinate muscular exertion. The heart's impulse is increased, and the radial pulse diminished, the respiration is more or less embarrassed, the functions of the cerebro-spinal system are disturbed, and especially those of the cutaneous capillaries.

Symptoms congestion in from sup-

The symptoms of congestion of the heart caused by a *suppression* of the *menstrual flux* are also, in many respects, similar to pressed discharges;

those produced by cold, or by violent muscular exertion. There is the same increased impulse of the heart, and diminished force of the arterial pulse; and there is more or less disturbance of the pulmonary, of the cerebro-spinal, and likewise of the capillary systems; but there is also a distinct difference in the *history* of the disease, for whilst in the first case the symptoms come on immediately on the application of the cause, in the other their progress is more or less gradual; an observation which applies generally to the symptoms of congestion arising from the suppression of all sanguineous discharges, and also to those from ulcers and eruptions.

and from the capillary system.

The symptoms of cardiac congestion derived from changes in the *capillary system* are also characteristic of this condition of the central organ. In proportion as the thoracic viscera are loaded, so are the cutaneous capillaries deprived of blood; and hence the coldness and paleness of the skin, especially of the hands and feet, and that cold profuse perspirations which accompany cardiac congestion.

Symptoms of congestion derived from the digestive organs.

The *digestive organs* also afford symptoms of a congested heart. "Sickness at heart" is not merely a figurative expression, for it often happens that when the heart becomes congested, especially from mental affliction, nausea and vomiting supervene. A lady, from a sudden and severe affliction, vomited almost incessantly for ten days; and in congestion from other causes, vomiting is by no means an infrequent symptom.

Case.

Symptoms derived from each of the hearts.

In prosecuting these inquiries on the symptoms of congestion, however intimately blended the symptoms of each variety of the disease may be with one another, yet we must expect to find an essential difference in the character of those which are derived from each of the two hearts.

See page 107.

On a former occasion I have pointed out the great difference in the apparatus and in the functions of the pulmonic and systemic heart,—differences which enable us satisfactorily to explain many of the phenomena in the diseases of each; and, indeed, nothing can differ more than the effects which congestion produces on the right and left hearts. Thus, when both the auricle and ventricle of the *right* heart become congested, the stagnation of the venous blood will cause more or less congestion

Veno-pulmonary congestion.

throughout the whole venous system; but in a congested state of the left heart, whilst the engorged auricle will impede the flow of the arterial blood from the lungs into the left ventricle, the congested ventricle will, at the same time, diminish the impetus of the arterial stream throughout the system.

Symptoms will also arise in congestion which may be considered common to both hearts; and it is the numerous changes in the pulmonic and systemic circulation to which we are to attribute those pathological phenomena so constantly observed in the congested heart and lungs; the various changes in the functions of the two hearts causing endless combinations of the symptoms.

Symptoms in congestion combined with diseases in other organs.

Besides all the symptoms of congestion which have been enumerated, from whatever cause a congested condition of the heart may have been produced, another order of symptoms will arise when the seeds of a latent disease is awoke in some other organ. In those persons who had previously been afflicted with a disorder, either of the heart or lungs, or of the brain or liver, these organs suffer in an aggravated degree when cardiac congestion takes place, and the combination of the two ailments causes a new assemblage of symptoms.

Symptoms derived from changes in the blood.

But there is an order of symptoms in congestion which derive their origin from changes that take place in the *qualities* of the *blood*; these being changed when congestion has been caused from inordinate muscular exertions, or by violent mental emotions; and though we may not be able to discriminate these symptoms, it is extremely probable that the changes produced in the heart's functions by changes in the blood qualities, become so intermingled with those symptoms which are produced by changes in its *quantities* within the cavities of the heart and in the coronary and pulmonary vessels, that we cannot expect such multiplied combinations of symptoms can be discriminated from one another by any physiological phenomena, far less by physical signs.

Reflecting on the numerous changes which are produced in the condition of the central organ in the varieties of congestion, and on the different phases of the disease, from differences in the causes by which it has been produced, as well as from the different parts, both of the pulmonic and systemic hearts, which may be affected, we readily perceive how difficult it must be to analyse and explain the various combinations of the symptoms. And, on taking a retrospective glance at the symptoms of cardiac congestion, there is not one of them, when taken separately, which may not be met with in other diseases of the thoracic viscera; so that it is only by examining the different combinations of them in each case, by which a correct diagnosis can be formed.

4.—*The Treatment of Congestion of the Heart.*

Treatment of congestion.

*To establish rational principles for the treatment of cardiac congestion is of primary consequence. The frequency of this condition of the heart, the vital organs under its influence, its pernicious consequence when not subdued,—all show the importance of this branch of therapeutics.

The treatment of cardiac congestion consists in fulfilling two indications: the one is to relieve the cavities of the heart and coronary vessels from the superabundant blood; and the other is to administer such medicines as will tranquillise the disturbed circulation and restore the qualities of the blood.

Bloodletting, when to be employed.

See page 320.

To fulfil the first of these indications, one of the most powerful means is *bloodletting;* and in resorting to this remedy we are, I may repeat, strictly imitating a process which Nature employs to relieve congestion,—a spontaneous hæmorrhage often taking place at some period of the disease either from the pulmonary, from the ethmoidal, or from the hæmorrhoidal vessels; and by which the symptoms are mitigated.

See page 320.

Rationale of its curative effects.

See page 115.

The curative effects to be anticipated from the abstraction of blood in cardiac congestion, are also illustrated by the physiological and pathological views which have been pointed out. It has been demonstrated, that if the cavities of the heart are congested and unable to evacuate their contents with their wonted force, and if a portion of these contents be removed, the power of the heart to expel the blood is immediately restored; and every one must have experienced the difficulty in voiding the first portion of urine when the bladder has accidentally been much distended; and how the remaining portion flows in a much fuller stream and requires a much less expulsive effort. This analogy is still further illustrated in the diseased condition of other muscular organs, such as the alimentary canal and the uterus.

The ingenious practice of Dieffenbach.

The same curative principle is admirably illustrated by the ingenious practice of Dieffenbach, who, attributing the failures of the Taliacotian operation, to the portion of displaced skin sphacelating, from a *congested* state of the cutaneous *capillaries*, perfectly succeeded in preserving the life of the displaced integument by keeping up a constant oozing of blood from the congested capillaries, applying in succession one leech after another until the adhesive process was completed.

In the treatment of cardiac congestion, bloodletting is to be employed, either generally or locally.

When there is a great increase in the heart's impulse, and much embarrassment in breathing, and especially if the disturbance of the circulation has been of short duration, *general* bloodletting ought to be resorted to, and a sufficient quantity of blood removed to tranquillise both the respiration and the circulation.

The blood should be allowed to flow as long as there is not any very sensible diminution in the impulse and sounds of the heart; but *syncope*, which is so powerful in subduing inflammatory diseases, must be, in cardiac congestion, carefully avoided, and especially if the congestion be accompanied with any other morbid condition of the *heart;* for it is in such cases where the too free abstraction of blood has been followed by pernicious effects, and led bloodletting to be deemed a dangerous remedy in diseases of the heart.

How the quantity should be estimated.

When a vein is opened the radial pulse should be carefully watched, and though it may retain a certain force, yet, whenever the ventricular contractions become feeble, no more blood should be abstracted. What opinion, then, can be formed of the discretion of him who can presume to order a patient to lose any particular quantity of blood, with the same confidence as he would prescribe a dose of any medicine?

Local bleeding, when to be employed. Leeches.

Unless the symptoms are urgent, *local* is preferable to general bloodletting; and the beneficial effect of *leeches* applied to the præcordial region is very remarkable. By employing leeches the risk of too much depletion is greatly avoided; for it will be almost invariably found that the bleeding from the leech bites is in

See page 322.

proportion to the fulness of the vessels. So that, according as the bleeding is profuse, in that degree will it be found useful,—an effect off leeches, which is one reason for preferring them to the operation of *cupping*.

Their derivative effects.

Leeches, too, must also have a *derivative* effect when they are applied to parts at a distance from the heart, as upon the feet; and in those cases of congestion where their frequent repetition is necessary, after they have first been applied to the præcordial region, they may, when repeated, be applied to the feet, so that on subsequent occasions the part be preferred from whence the bleeding gives most relief.

Other modes of diminishing the blood in the heart.

Besides the effects of abstracting blood, congestion of the heart is also to be relieved without removing any of the vital fluid from the system; and this is to be accomplished, as has already been explained, by *dry-cupping*, *rubefacients*, *friction*, and the *pedeluvium*.

See page 325.

Their utility explained.

As congestion of the cavities of the heart is accompanied by corresponding changes in the coronary and pulmonary vessels, the decided benefit derived from the application of leeches to the præcordial region can, I am persuaded, be satisfactorily explained by the vascular *anastomosis* which subsists between branches of the *coronary*, the internal *mammary*, and the bronchial arteries, and also upon the *pericardium* and root of the *aorta*.

See page 16.

Curative effects of the instinctive acts.

In the treatment of those suffering from a congested heart, the various *instinctive* acts which are performed by the respiratory and circulatory organs, and which are such unerring symptoms in the heart's disorders, ought not to be lost sight of in their treatment.

How to be imitated.

Of these acts there are some which we have the power of imitating. We can increase the blood into the heart by muscular exercise and by titillation, and we may change the respiration by swinging and rotatory motions, and we may cause vomiting, sneezing, and coughing,—all which acts unload the heart.

But when we have not the means of imitating these instinctive processes by which the loaded heart may be relieved, they ought not to be interrupted; and the other class, or those which increase the blood in the heart, ought to be equally guarded against. The pernicious effects of the restorative processes being checked, such as sometimes happens in consequence of their being under the influence of the *will*, are so well known that not only medical records abound with illustrations, but even the evil effects have not escaped the poet:

> "She never told her love,
> But let concealment, like a worm i' the bud,
> Feed on her damask cheek."

Shakspeare.

Curative effects of vomiting.

In as much as the act of *vomiting* is frequently resorted to by the economy for restoring a disturbed circulation, so may it be employed to relieve the heart when it has become congested; and there is no indication which more points out the propriety of administering an *emetic*, more than nausea or vomiting.

and of nausea. See page 229

Of no less consequence are *nauseants* in the treatment of congestion. The influence of nausea upon the heart has been fully explained, and its powers of diminishing the vigour of the circulation renders it a most useful remedy in the treatment of congestion.

To produce nausea there is no medicine more generally applicable than the preparations of *antimony;* and the mode of administering them I have already mentioned.

See page 371.

Treatment of the consecutive symptoms of congestion.

During the treatment of cardiac congestion a period will sooner or later arrive when it is expedient to discontinue the use of depletition and antimonials, or, at all events, to give them only in such doses, and at such intervals, as will not create nausea, and as long as they have a decided effect in alleviating the symptoms of the disorder.

This being accomplished, the heart often remains more or less irritable, the impulse is diminished, the sounds less intense, the pulsations are more frequent, and the radial pulse is feeble and tremulous. These symptoms may be occasioned either by a disordered state of the *muscular* parietes of the heart, which may have been present from the commencement of the congestion; they may depend upon changes in the *qualities* of the blood, or both causes may be combined.

Use of neurotics.

The irritable condition of the heart's parietes will be subdued by the administration of *neurotics*, and the state of the blood will be improved by *hæmatic* medicines.

Of the *neurotics*, opium, belladonna, digitalis, camphor, and ammonia, are all calculated to tranquillise the heart; and the mode of administering them has already been fully explained. See page 380.

and of hœmatics. In those cases of congestion wherein the *blood* is altered in its qualities, the *mineral* and *alkaline* medicines should be employed. Indeed, the beneficial effects derived from the use of hœmatic medicines after a depletive system of treatment has been adopted, and followed by neurotics, confirm the truth of the qualities of the blood having been changed in such cases of cardiac congestion.

Dietetics. The management of the *diet* of those suffering from a congested heart is of great consequence; for as such is the intimate relation between the heart and stomach, that the slightest impropriety either in the quality, in the quantity, or in the regularity of a meal often deranges a healthy circulation; so it becomes imperative for a person who is suffering from cardiac congestion not to partake of food either of a quality or in a quantity that cannot be perfectly digested.

With respect to *stomachic* medicines, they are generally hurtful in cardiac congestion. Bitters and astringents are pernicious not only during the congested state of the heart, but when it becomes irritable after the symptoms of the congestion have been removed. The disturbance which these medicines create in the vascular system of the alimentary canal is communicated to the central organ, increasing instead of allaying its irritability. See page 132.

Dermatics. The cutaneous surface is likewise a channel for the exhibition of some remedies in congestion. Warm and cold *bathing* in their various forms, *rubefacients*, and *blisters*, and the local application of *plasters* composed of *opium*, or *belladonna*, are all useful remedies, and the mode in which they are to be employed in the treatment of diseases of the heart has already been pointed out. See page 341.

Of no less importance in the treatment of cardiac congestion, is the regulation of the excrementitious processes; and the explanation which has been already given of the use of *purgatives*, *sudorifics*, *diuretics*, and *expectorants*, is strictly applicable to their administration in the treatment of congestion. See page 348.

Though the influence of respiration on the action of the heart has long been known to physiologists, except in cases of congestion from drowning, suffocation from inhaling noxious vapours, and from the influence of poisons, I am not aware of artificial respiration being much resorted to as a therapeutic agent. When John Hunter on one occasion found that his heart ceased to beat, he made a great effort to inspire, and the circulation was restored; and I alluded to the case of a man who was brought up from a coal-pit apparently lifeless, and who was completely recovered by artificial breathing and venesection. And the beneficial influence of vomiting upon the action of the heart explains the common practice of *miners* taking an emetic whenever they have inhaled a noxious gas.

Curative effects of artificial respiration.

See page 31

The observations which have hitherto been made on the treatment of cardiac congestion, apply chiefly to that congestion which has been caused by some inordinate muscular exertion; but it is evident that the treatment must be modified, not only by the peculiarities of each individual case, but likewise according to the cause by which the disorder has been produced.

Congestion of the heart arising from a *suppression* of the menstrual flux, may usually be relieved by bloodletting, combined with those medicines which have a specific action on the uterine system, and which relieve and regulate the *catamenia*.

Treatment of congestion from menorrhagia.

As a general rule, the most effectual mode of restoring the suppressed menstrual flux is to employ the chief remedial means one or two days previous to the usual time when it should appear; for there is doubtless a greater effort made by the economy at the approach of that period than at any other to restore the discharge, and therefore the curative measures are then assisted by the *vis medicatrix*.

"It commonly happens in the cases of suppression that though the menses do not flow at their usual periods, there are often at those periods some marks of an effort having a tendency to produce the discharge. It is, therefore, at those times, especially when the efforts of the system are concurring, that we ought to employ the remedies for curing a suppression; and it is commonly fruitless to employ them at other times, unless they be such as require some continuance in the use to produce their effects."

Cullen.

With regard to the abstraction of blood, two or three leeches should be applied to one of the feet the day previously to that on which the re-appearance of the flux is anticipated. The quantity of blood abstracted by the leeches will vary exceedingly, the wounds sometimes yielding but a small quantity, and in other instances the profuseness of the bleeding from so few leeches will appear surprising.

A few days before the arrival of the regular period, it is of importance that the *primæ viæ* be completely unloaded. And it is advisable to use those purgatives which act on the large bowels, and which more or less irritate the rectum and uterine system, such as *aloes*, the local irritation of that medicine contributing, along with the other depletive means, to restore the uterine function.

Though the chief remedial measures should be administered immediately before the accession of the regular period of menstruation, yet attention ought also to be paid to the general health before that period arrives. There is usually more or less tumult in the heart's action which the application of a few leeches to the cardiac region and the pedeluvium—or especially an emetic, will relieve. Any excited state of the cerebro-spinal system will be tranquillized by ammonia, camphor, and galbanum; and the digestive apparatus should be regulated, taking pains to discriminate any derangement which might have existed previous to the cessation of the menses, and bestowing upon such a special management.

If the means employed be sufficient to restore the menstrual flux, that event will usually be followed by an alleviation of the disturbance of the heart, and according to the degree of the subsidence of all the symptoms of the cardiac congestion must the future treatment be regulated.

Should the impulse of the heart not be subdued, leeches may again be resorted to, and applied either to the cardiac region or to the feet, or the tartrate of antimony, or James's powder may contribute to subdue the symptoms. But whenever the cardiac and arterial pulse are reduced in force, then *neurotic* medicines, such as opium, ammonia, camphor, may be administered, and continued as long as the heart's action is disturbed.

See page 389.

Precisely the same principles of treatment should be adopted in those cases of *veno-pulmonary* congestion which have been caused by a sudden stoppage of the *hemorrhoidal* flux. The plethoric

Treatment of

congestion from a suppression of the hæmorrhoidal flux,

state of the *portal* system which such hæmorrhages relieve, is a condition so frequently connected with a congestion of blood in the inferior cava vein and a corresponding stagnation of the venous blood in the right heart, that whenever that system is not relieved by the hæmorrhoidal flux, a corresponding congestion is caused in the venous system, especially in the veins of the right heart and head.

or the sudden healing of an ulcer.

When cardiac congestion has been caused by the sudden healing of an old *ulcer*, or by the drying up of some *eruption*, not only are the symptoms to be relieved by depletion, but a return of the discharge from the ulcer, or of the eruption, is to be encouraged by the application of emollients, and the introduction of a *seton* or *issue*; and cases are by no means rare where a fit of apoplexy has been caused from the neglect of such treatment.

Treatment of congestion from cold,

The treatment of congestion from *cold*, whether it has been applied to the cutaneous, or to the gastro-pulmonary mucous surface, should have for its object to restore the balance of the circulation, by employing such means as will increase the quantity of blood in the capillary system.

There is no remedy that fulfils this indication so quickly and so effectually as an *emetic*. The tartarised antimony, rubefacients, friction, the pediluvium, and the warm bath, along with ammonia and camphor, are also to be administered; and though in some cases blood-letting may be advantageously employed, it should be resorted to with great caution.

See page 330.

and from heat,

That cardiac congestion which has been caused by receiving into the stomach very *hot* substances, must require the same general treatment as when the congestion has been caused by cold drinks. The only remarkable case of this description which has ever come under my own observation, has been already referred to. The spontaneous bleedings from the nose which took place so frequently and for so many years in this patient, were, along with all the symptoms of congestion, relieved by the repeated application of two leeches on the præcordial region, along with antimonials and the preparations of iron.

See page 135.

and after amputation;

When the heart becomes congested from the stream of blood through an artery having been interrupted for the cure of an aneurism, or after a limb has been removed, great benefit will be derived from bloodletting; the *rationale* of which is quite apparent. Reviewing the numerous failures in the operations that have been performed for the cure of *aneurisms*, I am convinced that their want of success has, in many instances, arisen from the subsequent congestion of the heart and lungs; the pulmo-cardiac congestion having laid the foundation of those inflammatory attacks on the pulmonary system, to which the fatal result of these operations has been so frequently attributed.

after the operation for aneurism.

The effects of the *amputation* of a limb upon the condition of the heart are, in many respects, analogous to a stoppage of the circulation in an arterial trunk; but with this difference, that in the operation of *amputation*, there is always a more or less considerable loss of blood; whereas, a ligature may be placed upon an artery, and the operation cause but a few teaspoonfuls of the vital fluid to escape. This remark applies, indeed, to all great operations; for in the majority of cases, where they have proved fatal, death has been occasioned, not by inflammation of the wounded parts, but by inflammatory affections of some vital organ.

The principles of treating cardiac congestion that has either been caused by the exciting or by the depressing *passions* are in most respects different; the increased action of the systemic heart in the one, and its diminished action in the other case, will require, it is evident, very different systems of treatment.

When the action of the heart has been disturbed from an *exciting* passion, the congestion, if not relieved by the instinctive efforts of the economy, such as sighing and weeping, will be subdued by the abstraction of some blood.

But an opposite system of treatment must necessarily be employed in those cases of congestion which are caused by the *depressing* passions; for when the blood is congested from a diminution of the vital powers, in place of abstracting blood, which would still further diminish these powers, such cardiac medicines are required which increase the heart's vigour, and also those mechanical means which increase the circulation. At the same time we meet with cases, as I observed when considering the state of the sanguineous system in apoplexy, where both the arterial and venous systems are congested. The same assemblage of symptoms takes place in cardiac congestion, and similar principles of treatment should be adopted, both depletion and *neurotic* medicines being required. See page 171.

That congestion should be a frequent concomitant of alterations in the structure of the heart and lungs is not surprising, when it is considered, that such changes of structure will have the effect of rendering the heart less capable of propelling the blood with its natural velocity; and this accounts for the relief that is often obtained from a small depletion, even when there is extensive cardiac disease accompanied with debility; or when there is congestion of the heart, in consequence of diseased lungs, and the circulation is obstructed in the pulmonary vessels, such congestion may sometimes be relieved by the abstraction of a small quantity of blood.

It is when congestion takes place in consequence of some change in the heart's structure that depletion requires the greatest discrimination, the want of which has doubtless led in many instances to the improper use of bloodletting. The nicety in abstracting blood in such cases, arises from the circumstance that although the heart may be relieved, and the balance of the circulation be restored, yet if by abstracting the vital element the heart's stimulus be too much diminished, then follow those evil effects of depletion which are so much to be avoided.

Concluding observations.

Conclusion.—In the account now given of congestion of the heart, I have entered the more fully, because this interesting and no less important condition of the central organ of the circulation has never been pointed out as a *primary* disease, and its accompanying physiological and pathological phenomena have been only alluded to in a very cursory and superficial manner, by all those authors who have professedly collated a systematic account of the diseases of that organ. The views, however, which I have given, as well as the effects of the therapeutic measures on which the pathology of congestion has been founded, will, I am convinced, establish the true nature of this disease, and point it out as one of the most important of all the functional disorders of the heart. Nor could it have been anticipated that any satisfactory explanation of this condition of the central organ could have been given, without a previous knowledge of the three important functions of the circulating apparatus, which I have described, the *musculo-cardiac*, the *pulmo-cardiac*, and the *veno-pulmonary* functions.

The observations which I have made on the coronary circulation, and on the morbid condition of these vessels, also open an entirely new and interesting field of investigation, and one which has been most unaccountably neglected by those who have occupied themselves in investigating the diseases of the heart; and the circumstance that disturbances in the functions of the *coronary vessels* have never been hitherto taken into account by pathologists, explains one cause of the numerous errors which have been made in the diagnosis of diseases of the heart by those who ventured to draw conclusions from relying on physical signs.

The changes in the *sounds* which must necessarily be produced by a congested state of the coronary vessels, we could not expect to be discriminated even by the most tutored ear, and as no mention has ever been made of these sounds by stethoscopic observers, it is by no means improbable that they may have been attributed to other causes, and confused with other sounds, thus rendering any *diagnosis* founded upon such signs totally fallacious. Indeed, how could we rationally expect, when the heart's vigour is increased, to be able to discriminate by physical signs, whether that increase arose from an increase in the number of the muscular fibres of the heart's parietes, from a more irritable state of the internal surface of the heart, or from an increase in the stimulating powers of the blood, or from some nervous excitement?

CASES

OF CONGESTION OF THE HEART.

Cases of congestion of the heart caused by violent muscular exertion.

Case of congestion from running quickly.

Case I.—A young lady, unaccustomed to much exercise, was induced to run very quickly a short distance, which was followed by great embarrassment in breathing, and she consulted a physician, who, conceiving that she was affected with catarrh, prescribed expectorants, without relief to the breathing or to the cough which supervened. When she came to London, I was struck with the peculiarity in her respiration as she entered the room; and on applying my hand to the chest, the impulse of the heart was found much increased, and there was tenderness to the touch in the cardiac region, a slight agitation in the arterial pulse, with a short dry cough. The inordinate action of the heart was speedily relieved, and ultimately completely subdued by the repeated application of three leeches to the chest, antimonials, and strict attention to the digestive organs.

Case of congestion from running quickly, communicated by Mr. Noble.

Case II.—"An interesting youth was very imprudently induced to run after a squirrel, which he accidentally saw on a footpath, and so violent was the exertion which he made to catch it, that the effort was followed by intense pain in the cardiac region, accompanied with great embarrassment in breathing, and a swimming and uneasy feelings in the head. Five days afterwards he consulted me; he then complained of a good deal of uneasiness in the left side of the chest; the impulse of the heart was strong, and the radial pulse small and wiry; his respiration was imperfect, and he frequently sighed. Two leeches were applied to the cardiac region, the bite of one of which bled little, but from that of the other blood oozed during twenty hours. A dose of James's powder was given two successive nights, and on the third day the circulation was quite restored, and he only complained of some uneasy sensations about the muscles of the back and neck, which were attributed to the exertion he had made when running after the squirrel; these were completely relieved by two succeeding doses of Dover's powder. He continued well until three months after, when, in prosecuting some scientific researches in Switzerland, he ascended Mont Blanc, and on nearly reaching its summit, his breathing became so much embarrassed, that he was compelled to descend the mountain, and it was not until after several days of tranquillity that he recovered his natural breathing."

Case of congestion caused by walking quickly.

CASE III.—A young lady, when in perfect health, walked quickly across Hyde Park, being a good deal excited by a crowd that was assembled there. Her breathing became so much oppressed, and her heart palpitated so violently, that she was taken into an adjacent house and profusely bled, from which she experienced immediate relief. Since that time she has had nearly twenty similar attacks, all of which were brought on by too much walking, and all of them were relieved by bleeding. The last attack was occasioned by her running up-stairs very quickly, being at the same time greatly agitated; and upon this occasion the symptoms were also relieved by bloodletting.

Case of congestion caused by running.

CASE IV.—An eminent engraver who, though corpulent, was in good health, ran with all his speed to overtake a coach, and after getting into it he felt great exhaustion and a quickness in respiration, his heart at the same time beating violently. On getting out of the coach and attempting to walk, he did so with great difficulty, and the impulse of the heart with dyspnœa continued for several days, and were not relieved until after blood-letting, leeches, and antimonials had been employed.

Case of congestion from rowing a boat.

CASE V.—An officer, of great athletic powers, engaged in a rowing match, and which he won by unexampled exertion. On the following day he applied to me on account of an embarrassment in his breathing, caused by the violent exertion, as well as by intense anxiety from the interest created by the match. There was no sensible change in the arterial pulse, but the heart's action was so tumultuous that its beatings were apparent. Though the immediate symptoms were subdued by local depletion, the antiphlogistic treatment, and antimony, yet, for a long time, the heart was very susceptible of excitement, whether arising from disturbance of the digestive apparatus or from moral causes; and, as is usually observed in all organs which have been once injured, if from any accidental circumstance this patient's health was disturbed, that disturbance seldom failed to influence the action of the heart.

Extract from one of the patient's letters.

"For the last nine months, imagining that I had been perfectly well, never feeling any uneasiness in my heart, about a week ago I foolishly danced some reels, and that exertion brought back a return of my old complaint. I put on seven leeches the day I felt it, and applied mustard blisters twice, and have taken a good deal of opening medicine. I have not, however, got entirely rid of the uneasy sensation: sometimes it shows itself in a desire to draw a long breath; at other times I have a hot burning sensation around my heart, extending to the point of the shoulder, and a hissing, humming sort of noise in my left ear; and last night I have slept none the whole night, from a strong violent pulse, but not a very quick one."

All these symptoms were relieved by repeated bloodlettings and antimonials, and his health was permanently restored.

Case of congestion from rowing a boat.

CASE VI.—A student at Cambridge made a violent effort to win a rowing match, after which he suffered from great difficulty in breathing, a dry *cough*, and, finally, *hæmoptysis*, and to relieve these symptoms a depletive system of treatment was followed. About two months afterwards, the affection of the chest being still unsubdued, he was pronounced to have "a cavern in his lung;" and when the same physician again saw him, four months afterwards, after a lengthened stethoscopic examination, he pronounced that there was no cavern, and he was treated for pulmonary phthisis.

Sixteen months from the first attack, when he was suffering from a slight catarrhal affection, my attention was directed, from a slight stain of blood in the mucous expectoration, to the condition of the circulation. I found the radial pulse small, and the heart's impulse much increased; he had palpitation, and more or less tenderness on pressing the cardiac region. Three leeches applied to the chest bled profusely; a third of a grain of tartarized antimony was given twice a day, and the leeches were twice repeated, at intervals of two days, with complete relief.

Case of congestion from carrying a heavy weight.

CASE VII.—A chambermaid, who was daily in the habit of carrying coals up-stairs, became so breathless, as to be obliged to sit down and rest herself some time, before she could again begin to ascend the stair. After having suffered some weeks, she applied to me, complaining of very considerable difficultv in breathing, with a great increase in the impulse of the heart. By applying three leeches four times successively, and taking a dose of James's powder every night, she was relieved. Eight days afterwards she again complained of so great a difficulty in her breathing, that on walking a short distance, she was obliged to stop several times. On the following day the dyspnœa was very distressing, the impulse of the heart was much increased, but there was little change either in the quality or frequency of the arterial pulse. Four leeches were now applied to the region of the heart; they were repeated on the following day, and she took the third of a grain of tartarized antimony three times a day. The first leeches which were applied gave immediate relief, and she remained free from all dyspnœa, unless when she walked up a flight of stairs; this, however, soon abated, and the heart again beat with its usual impulse.

Case of congestion of the heart from singing.

The circulation becomes sometimes disturbed in persons who make great exertions in *singing*, or in playing wind-instruments, of which the following case is an example:—

See page 60.

A chorus-singer, of middle age, complained of a very distressing sense of tightness across the chest, limited and painful inspiration, and the heart's impulse was greatly increased, but there was little alteration in the arterial pulse. He had a very troublesome dry *cough*, which came on in paroxysms, and which was often excited on making a very slight bodily exertion. The digestive organs were not materially deranged. Since his early life he has been accustomed to sing, and five years ago, after great fatigue from singing in St. Paul's cathedral, the sense of tightness and difficulty of breathing commenced, and he has never been quite well since.

Three leeches were now applied on the præcordial region, which bled profusely; which, with a dose of James's powder given at bed-time, produced a very decided relief of all the symptoms, especially the sense of constriction of the chest, the frequency and severity of the cough, and the heart's impulse. After the antimonial powder had been taken four nights, the heart was tranquillized, and the respiration greatly facilitated. A dose of camphor and ammonia was afterwards given three times a day, and so manifest was the improvement, that, along with the compound *steel* pill, taken three times a day, and a *belladonna* plaster applied to the chest, in fourteen days from the commencement of the treatment, he considered himself so much recovered as to discontinue the medicines.

Cases of congestion of the heart from drinking cold water.

CASE I.—A school-boy, when overheated at play, drank a tumbler of cold water. On returning home in half-an-hour, he began to complain of an uneasy feeling in the chest, and an embarrassment in breathing; and after these symptoms continued for three days, he was bled at the arm, from which he derived immediate relief, and he completely recovered by the subsequent use of antimonials. Some time afterwards, I saw this patient in perfect health, not having had the slightest return of the above disorder.

CASE II.*—"A strong healthy man, aged about twenty-four, was mowing grass when the weather was warm, and he drank water brought from a neighbouring well, sometimes cold, but generally after it was warmed by the heat of the weather; the quantity of cold water taken at one time never exceeded half-a-pint. One evening talking gave him considerable anxiety, accompanied with sighing; and he found it necessary, during conversation, to rest occasionally. These complaints remained the same until two days afterwards, and when talking, he was suddenly seized with the like difficulty in his breathing, and vision nearly departed. He was placed on the bed, and lost nearly all sense and voluntary motion. I saw him in a few minutes after, and found his extremities cold, a livid suffusion of the face and neck, and his pulse about 35, with weak action, which, after the exhibition of a little hartshorn, gained preternatural force, more especially that of the heart. White tongue, a little thirst, deep and frequent sighing, and a little pain at the epigastrium at each pulsation. I did not bleed at this time, but substituted the warm-bath, and his pulse in a few minutes rose to 50 strokes in a minute, with less convulsive action. He fell into a warm sweat, and slept well. On the day following, he took saline draughts; pulse 28, a little hard, still stronger about the heart and large vessels, with irregular intermissions; the other symptoms as yesterday. Seven ounces of blood were taken from the arm; it was sizy; pulse during and after the operation, 33, but in the evening and night it beat only fourteen strokes in a minute. The bath was again administered, but without any advantage; he was costive, and had a dose of rhubarb, and took the saline draughts. Next day the pulse ranged between 14 and 28, till five p.m. At this time twelve ounces of blood were taken from the arm; pulse rose after the operation from 28 to 37 strokes in a minute, and at nine in the evening to 60 and softer; the other complaints much abated. On the following day, the pulse ranged between 30 and 50, but it was soft, his other complaints nearly gone. The day after, the pulse in the forenoon was 18, with anxiety, &c., but it increased in frequency, and in a few hours it stood at 54; a copious sweat then broke out, with an abatement of the anxiety, &c. He now became convalescent; but his pulse was slower than natural for several days till it arose to about 70; he was soon after, and ever since, able to take exercise and labour without inconvenience."

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* Abstract of a case entitled, "Case of Disease with a remarkably retarded Pulse."—*American Medical Repository*, vol. I.

Case of congestion of the heart from eating a hot potatoe.

A young man, nine years ago, ate a mouthful of very *hot potatoe*, and immediately afterwards fell down, and remained quite insensible for about ten minutes. Ever since that period he has suffered pain in the cardiac region, palpitation, and *epistaxis*. His hands are usually very cold, and the veins congested, but sometimes the cold is so great as to make the extremities of the fingers pale and insensible. The radial pulse is scarcely perceptible, but the heart's impulse is moderately strong. The palpitation is not constant, but usually succeeded any quick movements of the body, or mental excitement. The digestive organs were perfectly healthy. From the *epistaxis* occurring almost every day, I recommended the application of two leeches to the præcordial region, and a quarter of a grain of tartarised antimony to be taken twice a day; and the benefit derived was so decided, that he repeated the leeches four times. After a few days there was a manifest increase in the vigour of the pulse, and the impulse of the heart was diminished. He had no epistaxis after the first application of leeches; the capillary circulation in the extremities was much improved, and he was satisfied that a decided amendment had taken place. I now gave him the compound steel pill, which he took for some time with great benefit.

Case of congestion of the heart from mental excitement.

A lady suddenly lost one of her children, and her grief was so intense that she fell into a deep melancholy, seldom spoke, and could not weep. By regulating the alimentary canal, giving her occasionally a large dose of calomel, and repeatedly abstracting blood locally from the head, she gradually resumed her wonted habits. I saw her twelve months afterwards, and my attention was then arrested with an embarrassment in breathing; the impulse of the heart was much increased, and there was a contracted pulse. It appeared that she had never recovered from the moral depression caused by her son's death. Alternate bleeding by leeches from the parietes of the chest and the feet, along with antimonials and narcotics, produced the most beneficial effects, and ultimately she completely recovered.

Cases of congestion of the heart from disturbed sleep.

CASE I.—Mrs. —— complains of a sensation of giddiness both when she is in the erect and horizontal postures; uneasiness in the chest, upon which she cannot suffer even the pressure of the bed clothes; she frequently feels the beatings of the heart, and she has a frequent and troublesome dry cough. The radial pulse is frequent and tumultuous, all which symptoms have been present the last six days. Two leeches which were now applied to the cardiac region bled moderately, and she took a dose of

James's powder at bed-time, and she slept better the following night than she had done for two months previously, as during that period she had been in constant attendance on a sick daughter, and her sleep was often interrupted, and being often awoke suddenly.

Case II.—A nurse complained of a disagreeable sensation in the head, which afflicted her at all times of the day, but especially when she walked, and then it became so severe that she could not balance herself; and on several occasions she was compelled to take hold of some support to prevent herself falling. She also had *tinnitus*, sometimes in one, and sometimes in both ears. The digestive organs were in a healthy condition; her pulse was natural in frequency, but rather small; the impulse of the heart was strong, and she complained of tenderness on pressing upon the cardiac region, causing a sob and difficulty in breathing. She had been for six months kept constantly watching a sick person, and seldom slept one hour at a time; sometimes being awoke four or five times in an hour, for several successive hours. She also complained of fearful apprehensions of death when these sufferings were brought on, though, on other occasions, she felt no such terror, but rather a wish to die. By the repeated application of a few leeches on the chest every second and third day, along with small doses of the tartrate of antimony, the state of the circulation became perfectly natural.

Case of congestion of the heart accompanied with irregular menstruation.

A lady, fifteen years of age, had been afflicted nearly two years with difficulty in breathing on the least bodily exertion; and during that period had eight paroxysms, during which she was seized with dyspnœa and violent palpitation. For the relief of all these attacks she was bled at the arm, confined some days to bed, and attention paid to the digestive organs. On the return of an attack, she applied to me, when I found the radial pulse frequent, but easily compressed, and she had violent palpitation of the heart. One leech was applied to the foot, and the pediluvium employed afterwards. In three hours she experienced great relief in the chest, and perspired profusely, a circumstance unusual with her. She took repeated doses of

James's Powder, the bowels were easily regulated, she speedily recovered, and gradually passed into a state of uninterrupted health.

Congestion of the heart from causes not manifest.

Though a congested state of the heart will seldom be met with wherein the origin of the disease cannot be satisfactorily ascertained, yet I have frequently seen cases in which no distinct cause could be assigned; but where the assemblage of symptoms, and the successful result of the treatment explained the true nature of the malady. This is no more surprising than what is observed of other organs; derangements in their functions frequently taking place without our being able to assign these to any particular cause.

Case communicated by Mr. Mackilpin.

Case I.—"A girl, seven years of age, of spare habit of body, had been in ill health about nine months, during which period she was several times seized in the night with the most violent alarm, springing from her bed, screaming, and running about the house. She had been treated for an affection of the stomach by two physicians, but without benefit. I found her labouring under violent continued action of the heart; the spaces between the intercostal muscles were protruded at every contraction of the ventricle; the radial pulse was proportionably strong; her tongue was slightly furred, and the bowels were sluggish. The treatment I now adopted consisted in the application of two leeches to one foot, every fourth day; mild aperients, and light diet. This plan was pursued for three weeks, when the patient was so much improved, that the leeches were discontinued, and small doses of sulphate of iron, with infusion of gentian, were given twice a-day; a mild alterative and aperient at night. At the end of a month the action of the heart was reduced to its natural state, and the patient was restored to health, and remained free from any affection of the heart when I saw her, after a lapse of more than three years."

Case II.—A footman complained of a sensation of tightness in the chest, sometimes amounting to pain, and there was tenderness on pressing upon the cardiac region. He could not inspire fully without uneasiness, and on going up stairs found difficulty in breathing. The radial pulse was rather small, and of natural frequency, but the impulse of the heart was greatly increased. He had suffered these uneasy feelings about three months, and they had never abated; no cough, and the digestive organs were healthy. He can assign no cause for his illness. He took the third of a grain of the tartrate of antimony twice a-day for three days, with only slight relief. Two leeches were now applied to the cardiac region, which bled three hours freely; and on the following day, all the uneasy feelings in the chest were gone, the heart's impulse subdued, and the radial pulse had become soft. He continued the antimonial pills, and took altogether sixteen of them; at the end of which period he appeared to be, in all respects, in perfect health.

Case III.—The clerk of a solicitor complained of a severe and unceasing pain in the præcordial region, which was much increased by slight pressure, and was accompanied by an uneasy sensation in the head, limited to the occipital region; great debility, coldness of the legs and feet, imperfect sleep, and often suddenly interrupted. The impulse of the heart was increased, the radial pulse was small, compressed, and of its natural frequency. All these symptoms had been of only a few days' duration, and had come on without any evident cause, unless from having been exposed to a good deal of mental fatigue. Two leeches were applied to the præcordial region, and repeated four times at the interval of one day between each application; and during the same period he took eight grains of the tartarized antimony, divided into twenty-four doses. The effect of these remedies was to relieve the local pain, to diminish the heart's impulse, and to render the arterial pulse softer. He still, however, complained of palpitation and mental irritability, which camphor and ammonia failed to relieve, but which completely yielded to the exhibition of two drops of the dilute *hydrocianic acid* twice a-day. For some time afterwards these symptoms occasionally recurred, and on every occasion they were subdued by the acid.

Cases of Congestion of the heart accompanied by cough.

Case I.—A lady of middle age complained of a *cough*, which came on at all hours in violent paroxysms, preventing sleep, and accompanied by an embarrassment in breathing, great difficulty in ascending a stair, and great increase in the heart's impulse. The digestive organs were natural. She had found no relief from an antiphlogistic treatment. The cough came on four months before she consulted me, immediately after walking quickly in a cold day, and it had since continued. Previously she had occasionally suffered from palpitations. I prescribed one grain of the sulphate of zinc, with the compound galbanum pill, to be taken twice a day. The first pill produced a manifest abatement of the cough; on the second day it was still more diminished, both in severity and frequency; and on the fourth day it was quite subdued; but she continued the pills altogether for six days. A corresponding change took place in her breathing, and the impulse of the heart was reduced to its natural standard.

CASE II.—A lady, twenty-eight years of age, complained of a *cough* so severe, that for many nights she had been obliged to sit up in bed. The impulse of the heart was so much increased that she frequently felt the heart palpitate, especially on making the slightest bodily or mental exertion. By the application of a couple of leeches upon the chest, and a dose of James's powder at bed-time, and by twice repeating the leeches, at intervals of three days, along with the antimonial, all the symptoms were subdued, and the respiratory and circulating organs were restored to a healthy condition.

Congestion of the heart, accompanied by sickness and vomiting.

CASE I.—A governess in the twenty-fifth year of her age, had been suffering, for upwards of twelve months, from a cough, which was accompanied by occasional sickness and vomiting, and which had been treated with a variety of expectorants. The radial pulse was small, and of natural frequency; the heart's impulse was increased in strength; there was tenderness in the cardiac region on gentle pressure; a dry cough came on in severe paroxysms, and sometimes ended in the vomiting of a tough transparent mucus; the digestive organs were deranged and the menses were irregular. By the application of three leeches to the præcordial region, an emetic, and the tartarised antimony continued for a few days in small doses, all the symptoms were completely subdued, and she was soon restored to perfect health.

Case II.—A lawyer's clerk, soon after getting out of bed, felt sick, but he did not vomit. He experienced sickness every day during a month, which came on at all hours, particularly after breakfast. The arterial pulse was small and irregular; the impulse of the heart strong and tumultuous, with irregular pauses; and the digestive apparatus was healthy. After taking one-fourth of a grain of tartarised antimony morning and night for six days, the symptoms were so much subdued that he required no other medicine.

Congestion of the heart accompanied by Epistaxis.

A housemaid, eighteen months ago, after great bodily fatigue was attacked with *epistaxis*, which returned twice a day for several successive days, but the quantity of blood lost was small. Some time afterwards, having suffered from an uneasy sensation in the abdomen, she *vomited* some blood: and though she never recovered her strength, there was no return of the epistaxis until three weeks before she was placed under my care. From that time the nose usually bled three times a day, the blood flowing in a continuous stream for about half an hour, and the quantity she estimated to be not less than half-a-pint each time. She had now become extremely feeble and emaciated, and quite incapable of any exertion; her breathing was greatly embarrassed, and she could not ascend a stair but by repeated efforts. She had a frequent dry cough, which generally came on in paroxysms. Her pulse was feeble and of natural frequency. The heart's impulse was vigorous, and she sometimes felt its palpitations. There was a tenderness over the whole præcordial region, the catamenia had continued regular, and the digestive organs unimpaired. Not finding any benefit from a few doses of the tartrate of antimony, two leeches were applied to the præcordial region, and the blood flowed six hours, after which she was immediately relieved of the uneasy feelings and oppression in the cardiac region, and a remarkable diminution in the frequency and severity of the cough and in the difficulty of breathing. During three subsequent day-she repeated the antimonial pill, from which she did not appear to receive any benefit; and, on the fifth day from the commencement of the treatment, she took twice a day the compound steel pills. After taking six of them, she had no return of the epistaxis, and the cough, uneasy feelings in the chest, and beatings of the heart, and every symptom of her disorder were subdued. She continued to take the steel pills; and when I saw her, six weeks from the commencement of the treatment, she had become much stronger, her general health restored, and she had no return of her complaint.

Cases of Congestion of the Heart accompanied by Hæmoptysis.

Case I.—A painter, middle aged, applied to me on account of a spitting of blood, frequent short cough, difficulty of breathing, with uneasy feelings in his chest. The radial pulse was small, and not increased in frequency, but there was a considerable increase in the impulse of the heart. Three leeches were applied to the præcordial region, and repeated in two days. The tartrate of antimony, combined with calomel, was at the same time administered, and after this treatment was continued for a week, the symptoms were all subdued, except the cough. He was then ordered squills, combined with ipecacuhana and the common mercurial pill, and this treatment being continued during ten days, he considered himself convalescent, and used no further remedies.

Case II.—A young lady applied to me on account of a teazing cough, accompanied occasionally with a spitting of a small quantity of blood, from which complaint she had suffered several years, and had spent six seasons abroad; several physicians whom she had consulted having treated her for pulmonary phthisis. She had a small thready but not a frequent pulse; and the impulse of the heart was considerably increased. Her breathing was slightly embarrassed, and she had occasionally uneasy feelings in the chest.

By the application of a couple of leeches on the cardiac region, and repeating them in a few days, at the same time taking a dose of James's powder every night, the cough and hæmoptysis were subdued, after which her general health and strength rapidly improved by the use of the compound steel pill; and when I heard of her some time afterwards, her complaint had not returned, she had married, and was the mother of a family.

Case of congestion of the heart succeeding hooping cough.

A youth applied to me on account of a cough with which he had been afflicted since an attack of hooping cough five months previously. The cough was dry, came in paroxysms, and was troublesome during the night and on getting out of bed. The heart's impulse was vigorous, and the radial pulse small. Two leeches were applied to the præcordial region in the evening, and the bleeding did not cease until the following morning; a dose of James's powder was taken at bed-time. The day after the leeches were applied there was scarcely a vestige of cough remaining; and after taking James's powder for three nights, I ordered him the compound steel pill, which he took twice a day for ten days. Since which he has had no return of the cough, and his general health is completely restored.

Case of congestion of the heart accompanied by hiccup.

A gentleman, fifty-five years of age, had a severe apopletic fit, accompanied with loss of power of the left side, and of the intellectual powers. The symptoms were subdued by small depletions and evacuants, and six months afterwards, during his convalescence, he was seized with an incessant hiccup, and after having made use unsuccessfully of a variety of medicines, my attention was directed to the heart, the beating of which was tumultuous. I ordered him one grain of crude opium every two hours, and applied a belladonna plaster to the præcordial region, and after taking two of the pills the hiccup did not return.

Case of congestion of the heart accompanied by muscæ volitantes.

Mrs. ——, in the forty-fifth year of her age, applied to me on account of *muscæ*, which appeared before the left eye, along with occasional "swimming in the head." She is easily excited and alarmed. She complained of uneasy feelings about the upper part of the chest and root of the neck; a feeling of tightness accompanied by pain in the cardiac region, and a difficulty of expanding the chest; a dry cough which comes on in the morning when rising out of bed, and which is sometimes very violent, and is, during the day, more or less troublesome. Her face is flushed and puffy, and she is suffering from cold legs and feet. The slightest movements of the body, or any mental excitement, cause palpitations, and these also she sometimes suffers from when in bed. The radial pulse is small and oppressed. The impulse of the heart is greatly increased, and pressure on the cardiac region gives pain. The digestive and uterine systems are healthy. The uneasy feelings in the chest have been distinctly marked at least eight years, and twelve months ago the false images first appeared before the left eye.

I recommended *two* leeches to be applied to the cardiac region, and one third of a grain of the tartrate of antimony with rhubarb and soap to be taken night and morning. The leeches bled profusely, and one continued to bleed *twenty-six hours.* Most decided relief was obtained from the bleeding; the antimonial pills caused no sickness, but operated frequently and copiously on the bowels. She now took a dose of ammonia and camphor two or three times a day; and on the seventh day the cardiac and radial pulse had become quite natural, the uneasy feelings in the chest and tenderness to the touch, and the uneasy feelings in the neck, were subdued; the flushing of the countenance had disappeared. She now discontinued the antimony, and took the *pill. ferri c. myrrh* and a mixture of *camphor, rhubarb,* and *ammonia,* and after continuing these medicines about three weeks, she returned home perfectly well in all respects except "the false images" which appeared before her left eye,—these not having undergone any change.

Case of congestion of the heart, accompanied with a loss of power in the fingers of one hand.

A young lady of a pale and delicate frame, applied to me on account of an affection of the right hand, with which she had been afflicted about eighteen months. All the fingers and the whole hand, as far as the wrist, were quite motionless and slightly œdematous, but the sense of touch was unimpaired. During this period, the motion of the fingers had several times returned and was again lost; and in these different attacks the longest period that motion was lost was about fourteen weeks. She had used a variety both of local and general remedies, without the least benefit.

As there was a considerable increase in the impulse of the heart, I thought it possible that the affection of the hand might arise from the heart being congested and causing some disturbance in the circulation of the *motor* column of the spinal chord. I recommended her to lose some blood from the vicinity of the heart. Three leeches applied to the cardiac region bled profusely, and the motion of the hand and fingers was in a few days quite restored.

During five years afterwards she had repeated attacks, these commencing with an uneasy sensation in the muscles of the forearm; a short time after which, the hand and fingers lost their power of motion. On none of these occasions did the movements ever return until leeches were applied to the chest, and these never failed to produce the desired effect in three or four hours. The average number of leeches which she applied were three on each relapse, and during which time she kept a regular account of the number, exceeding twelve hundred in five years.

During the last year she has only applied leeches three times, and although the attacks have been frequent, they have all yielded to dry cupping on the cardiac region. When I last saw her she was in good health, except being occasionally troubled with slight palpitation.

CHAPTER XXII.

FUNCTIONAL DISORDERS OF THE HEART FROM A DIMINUTION IN THE QUANTITY OF ITS BLOOD.

Effects of the loss of blood on the heart; syncope; different causes of; treatment of; anæmia, its symptoms and treatment.

"The heart acts best," observes Hunter, "with a moderate quantity of blood." If it be congested, then follow all those phenomena which have been so fully described; but if the quantity be diminished below the natural standard, then symptoms are developed of a very different character.

The effects of a diminution of the heart's blood we have opportunities of observing, where a large quantity has been abstracted from the body artificially, or in consequence of a severe hæmorrhage, such as often occurs during parturition. In either of these cases the cardiac and radial pulse at first become quickened, and gradually lose their vigour, until they can no longer be perceived to beat; the intellectual powers fade; after which *syncope* supervenes.

If the depletion has not been such as to destroy life, the fainting state is followed by a series of phenomena, all which are the effects of those instinctive acts of the economy, employed by the *vis conservatrix* to increase the quantity of blood within the heart, and, by the influence of the musculo-cardiac function, invigorate the circulation. "Hence, fits of syncope are frequently attended with, or terminate in *vomiting*, and sometimes in *convulsions* or an *epileptic* fit." Cullen.

It may further be observed, that a fainting state, caused by a spontaneous hæmorrhage, becomes one of the means which nature adopts in order to arrest the bleeding; for not only does the languid state of the circulation, produced by the loss of blood, favour its coagulation and the formation of a clot on the mouths of the bleeding vessels, but it has been ascertained, by experiments on living animals, that the more frequently they are bled, the more speedily does the remaining blood coagulate.

It has been already stated, that syncope is one of those acts which are resorted to by the economy to relieve certain disturbances of the heart, the fainting state causing such a diminution in its vigour, and consequently in the impetus of the blood, that the circulation recovers its natural state.

There is another cause of fainting occasionally observed, which does not arise from the loss of blood, but from its unequal distribution. When, by the sudden evacuation of the water in *ascites*, the blood is allowed to flow into the vessels from which all the pressure caused by the distension of the water is removed, the quantity of blood in the heart and large vessels is proportionally diminished, and thus syncope ensues.

Case narrated by Lefevre.

A lady who had immense varicose veins of both legs, fainted whenever she was in the erect posture, the veins becoming reservoirs of a large quantity of blood; so that the balance of the circulation was destroyed, and the cerebro-spinal system deprived of its due quantity of the vital element.

Syncope may also arise from a diminution in the vigour of the heart, by the influence of the nervous system. Of this condition of the circulation we daily see examples; and it is sufficient here to refer to observations already made on the influence of the depressing passions in diminishing the action of the heart. See page 165.

The syncope that is caused by an obstructed circulation, from a change in the structure of the heart, is of a far more serious character than fainting, either from a profuse depletion, or from mental emotion; for, if a fit of syncope takes place when the heart's tissues are diseased, such interruptions to the transit of the blood through the heart must always be considered as indicating some important change in the heart's apparatus. Hence a fainting state, and even complete syncope, is by no means an unfrequent symptom in many organic diseases of the central organ; and when this condition continues beyond a certain time, life is extinguished; so that syncope is frequently the immediate cause of death in those who have long been suffering from a diseased heart.

Treatment.—In syncope from the loss of blood, the vigour of the heart may be restored by the administration of those remedial means which stimulate the nerves of the heart, and likewise by those which increase the quantity of its blood.

The first of these indications is fulfilled by stimulating with neurotics the gustatory, the olfactory, and the cutaneous nerves, with all which the heart has an intimate relation. The second indication is accomplished by the horizontal posture, and by applying a ligature, or tourniquet, on one or both of the extremities, in such a manner that, by stemming the vital stream which supplies them, more blood remains in the heart and brain. See page 29.

The good effects of *vomiting* ought likewise to be kept in mind —an act which the economy employs to restore the circulation in syncope: and for the same purpose artificial *respiration* may be beneficially employed.

Anemia. Besides the syncope from an excessive loss of blood, other changes are produced in the condition of the heart. Palpitation comes on more or less violently, the respiration is accelerated, both which symptoms are greatly increased on the least bodily exertion or mental emotion. The cutaneous surface becomes pale, there is great general debility, and ultimately anasarca.

These changes in the sanguiferous system are not only the effects of a diminished quantity of the mass of blood, but likewise of changes in its qualities, the shock which the economy receives after a profuse hæmorrhage, rendering both the processes of incretion and of excretion imperfectly performed, by which changes are produced in the elements of the vital fluid.

In the treatment of such cases, all those remedial means should be employed which regulate and improve the incrementitious processes. Thus *stomachic* medicines may be advantageously had recourse to, in order to aid digestion; a salubrious atmosphere will assist respiration; the condition of the cutaneous surface will be improved by *dermatics*, and the blood itself by the administration of *hæmatics*.

CHAPTER XXIII.

FUNCTIONAL DISORDERS OF THE HEART FROM CHANGES IN THE QUALITIES OF THE BLOOD.

The phenomena and causes of changes in the qualities of the blood; the numerous changes in the blood disturb the heart, and likewise the different systems of the animal œconomy; the humoral pathology founded on these changes of the blood; influence of the digestive, respiratory, and cutaneous systems in changing the blood; other causes by which the blood is vitiated; how minute portions of extraneous matters change the blood illustrated in inorganic fluids; rapidity of these changes; the nature of the changes of the blood little understood; the limited aid which has been derived from chemical science; importance of chemistry and physiology combined; the symptoms, diagnosis, prognosis, and treatment of the functional diseases of the heart caused by changes in the blood.

General observations.

We come next to consider the functional disorders of the heart, which are caused by changes in the *qualities* of the blood; for however frequent may be those functional diseases which arise from changes in the blood's *quantities*, yet far more numerous are those which are produced by changes in the qualities of that vital fluid.

The numerous changes in the blood which disturb the heart.

And when we contemplate the vast number of changes which the blood must necessarily undergo, from differences in the qualities of the elements with which it is supplied at different times, and from differences in the manner in which the processes are performed in the vital laboratory, disturbances in the functions of the heart must be constantly taking place.

We cannot contemplate the functional disorders of the heart, that are caused by changes in the blood, without being at the same time impressed with the disturbances which these changes create in other systems of the economy: for in like manner as it has been shown, that there is a general law by which some medicinal bodies act upon certain organs, so it appears as regards the presence of any noxious elements in the blood, each of these

See page 362.

creating disease in a particular organ. Thus the liver is affected in some, the spleen in other fevers; and the mucous membrane of the intestinal canal suffers in Cholera.

We must not, therefore, view the functional disorders of the heart produced by changes in the blood, in an isolated manner, for it is legitimate to infer that not only particular organs are deranged, but that the presence of the vitiated fluid will influence more or less the whole sanguiferous system. "The poison itself is the remote, but the vitiated state of the blood, produced by the poison, is the immediate cause of fever; as certain as the narcotic poisons when injected into the veins, constantly destroy the vitality of the blood and cause death."

Stevens on the blood.

It was from these changes in the qualities of the blood the school of the "Humoral Pathololigists" was founded, and however erroneous may have been some of the conjectures, and however hypothetical some of the doctrines of its disciples, regarding the nature of these changes, there cannot be a doubt but that essential alterations in the qualities of the blood do take place in many diseases, and that the blood exercises an extensive influence not only on the functions of the heart, but also upon the whole animal economy; affording incontrovertible evidence of the truth, that changes in the quality of the blood, or "errors in the fluids," are the proximate cause of diseases.

Origin of the humoral pathology.

Before proceeding further, it may be well to observe, that in speaking of the *blood* in these pages, the *arterial* blood is meant to be understood, unless the *venous* be distinctly specified; for, in most physiological and pathological writings, the *kind* of blood is seldom mentioned. This is much to be regretted, as there are, doubtless, essential differences in the two bloods, though chemical science has not yet determined many of them. The differences in the arterial blood is the cause of many diseases; whereas, the venous blood, having passed through the various secreting organs, must essentially differ from the arterial blood, from the vital processes which each organ performs. It is also to be taken into consideration, that almost all the experiments on the human blood have been made on blood taken from veins in the *arm;* thus rendering it impossible to draw any general conclusions on the nature even of the venous blood. The

Differences in arterial and venous blood.

Brand.

opportunities of analyzing the *arterial* blood have not all been taken advantage of; and, though the menstrual flux has been carefully examined, there has been no minute analysis yet made of the hæmorrhoidal flux, or of the blood of epistaxis and hæmoptysis.

Causes which change the blood.

So numerous being the changes produced in the blood even when the body may properly be considered in a state of health, we are led to anticipate that, by the varied disturbances of the digestive, respiratory, and cutaneous systems, changes will take place in the qualities of the vital fluid which cannot fail to produce corresponding derangement in the functions of the heart; and although the nature of these changes have not been defined, we cannot doubt of their existence.

Influence of the digestive functions on the blood.

The *digestive* apparatus, whether from a disordered condition of its own functions, or from receiving improper food, will eliminate chyle of an unhealthy character, which, after being mixed with the blood, must not only taint the sanguiferous system, but influence the functions of particular organs.

Thus, when the salivary glands, the pancreas, or the liver, do not duly perform their functions, the changes in the different fluids which they secrete must alter the quality of the chyle, and consequently produce changes in the blood. So likewise differences in the quantity and quality of the food, will produce no less important changes in the incretions. On these differences is founded the whole system of *dietetics*. Living upon *salted* meats alone, or upon *sugar*, or *albumen*, materially injures the health by the changes they produce in the blood.

The effects of derangements of the *excrementitious* processes by contaminating the blood and disturbing the functions of the heart, are equally striking: for when the excretions are not separated from the blood, the vital fluid remains permanently vitiated, disturbing not only the functions of the heart, but those of the whole sanguiferous system. Of this we have abundant proofs, when excrementitious matters are detained in the alimentary canal.

Effects of the re-absorption of excreted fluids.

Or when excrementitious matters have been separated from the blood, and afterwards *re-absorbed* and mixed with the vital fluid, remarkable disturbances take place in the sanguiferous system. Thus, in long retentions of *urine*, during which the secretion is not only diminished, but urine contained within the bladder is reabsorbed and mixed with the blood, the functions of the heart become deranged, great excitement being created throughout the whole system; and those who die from retention, perish not from disease of the bladder, but from the poisonous effects of the urine which is mixed with the vital element.

The absorption of *purulent* matter is no less injurious; and when the blood becomes contaminated with it, the frequency of the heart's action is increased, and the patient becomes *hectic*. The same phenomena as those produced by the reabsorption of other excretions are also observed in jaundice, where the *bile*, after it has been secreted is reabsorbed, and mixed with the general mass of blood; and, when the *milk* has not been excreted from the mamma, and reabsorbed and mixed with the blood, the circulation is greatly disturbed.

Influence of the respiratory organs.

The organs of *respiration*, either from an imperfection in their function, or from noxious ingredients in the air which is inspired, must cause changes in the qualities of the blood; which changes will not only derange the functions of the heart, but produce injurious effects on the whole animal economy.

Changes in the pulmonary absorption.

As the qualities of the chyle are modified by differences in the mode in which the digestive function is performed, so we may anticipate that the ingredients in the atmosphere which are absorbed by the lungs will not always be the same, but will differ, according to the condition of the pulmonary apparatus; and that the lungs will separate from the air different elements, just as the digestive canal separates different ingredients from the aliment. And, as differences in the qualities of the food cause changes in the chyle, so it will happen that differences in the atmospheric air will create corresponding changes in the pulmonary absorption.

Their nature not explained.

These various changes in the blood which must necessarily take place in the lungs, both in health and disease, have hitherto evaded chemical research. That they do not depend upon differences in the proportion of oxygen and nitrogen contained in the air is quite certain, for this never varies in any place or in any climate; the arterial blood, however, has not always been found to contain the same proportion of these elements.

Besides, there are constituents in the atmosphere, the presence of which we only know of by their noxious influence on the animal economy, and which influence must be the result of changes which they produce in the blood. The paroxysms of asthma, the rheumatic pains that afflict many persons upon every change in the air, and the history of epidemic diseases, are all striking examples of atmospheric agencies.

Changes in the pulmonary exhalation.

The functions of the heart are likewise modified by changes in the excrementitious processes which are performed by the respiratory apparatus, and when the pulmonary excretions are not duly separated, the blood becomes tainted, creating disturbances throughout the sanguiferous system.

Influence of the cutaneous system on the blood.

The *cutaneous* system contributes also an important share in modifying the qualities of the blood, both from the matters which it absorbs, and from those which it separates and discharges from the system. When either of these functions of the skin are interrupted, or not duly performed, the blood becomes more or less vitiated, and corresponding derangements take place in the action of the heart.

Other causes of changes in the blood.

Besides the multiplied changes in the blood, arising from the derangement of the digestive, respiratory, and cutaneous systems, there are also other causes which contaminate the vital fluid.

From organic diseases.

Whenever the function of any organ of the body is deranged, changes almost always take place in the qualities of the blood; and thus the pale, squalid appearance of the cutaneous surface, as well as the disturbed heart, are most striking characters of some organ being diseased by a vitiated blood.

From organic diseases of the heart.

And from malformation.

Changes in the blood's qualities also accompany many diseases of the tissues of the heart as well as disorders of its functions, and there are serious disturbances in the action of the heart in many of those cases of *malformation*, where the venous and arterial bloods are mixed.

Besides these changes, all of which disturb the heart's functions, the blood is also contaminated in specific diseases, as in *scrofula, syphilis*, and in the *exanthemata*. Also in *anæmia* the blood is changed from an imperfection in some of the incrementitious processes; and when the lungs, the digestive organs, or the skin, are diseased, the imperfect manner in which their functions are performed, produce changes in the blood.

Blood changed by minute portions of matter.

Numerous as these manifest causes are which alter the blood, there are none of them, however inconsiderable they may appear, which will not exercise a more or less important influence on the functions of the heart. This we may venture to conclude from analogy, comparing the effect of very minute portions of some medicinal substances on the human body, with the extensive chemical changes of inorganic fluids, produced by apparently inadequate causes.

Thus illustrated.

Liebig.

The effect of a small quantity of certain substances, such as of *yeast;* on comparatively large quantities of matter, transferring it into new compounds, shows how minute a portion of certain substances introduced by the lungs or absorbed by the alimentary canal, or by the skin, may cause a complete transformation of the whole mass of the vital fluid; and, in like manner, as the slightest chemical action—the mere contact of atmospheric air excites a new arrangement of all the atoms of dead animal matter whilst undergoing decomposition, it is legitimate to conclude that changes in the blood may be effected by equally slight causes.

"A little leaven leaveneth the whole lump."

Nature of the blood's ingredients yet undetermined.

Further, when we consider how exceedingly minute the portion of any noxious matter in the atmosphere may be by which the whole mass of blood can be contaminated, it was not to be expected that such ingredients could be separated. The chemical philosopher has not been able to obtain from the blood those elements, so as to ascertain their nature, more than he has succeeded in separating the molecules of an odorous substance, as those of *musk,* diffused through a large bulk of air, though of their presence we have indubitable testimony by the sense of smell.

The nature of the processes performed by the various organs, from the time when the incretions enter the blood, until the excretions are separated from it, not having been explained, we could not anticipate that the elements, qualitative and quantitative, with which the blood is furnished, would be accurately ascertained, nor could we, without a previous knowledge of the nature of these varied constituents of the blood, refer changes of the heart's functions to corresponding changes in the blood's qualities.

In a few instances this has certainly been accomplished. One of the most remarkable changes of the blood, accompanied by a great increase in the heart's action, is in *chlorosis*, in which disease there is a diminution in the proportion of the *red globules*. In other diseases, where the heart's action is deranged, such as inflammation, there is an increase in the proportion of *fibrine*. In the Asiatic Cholera there is a diminution in the proportion of *serum*; whereas in scurvy, and after violent muscular exertions, the blood loses its *coagulating* power; and a similar change takes place from mental emotions, and from the influence of electricity.

See page 114.

"To interrogate Nature," observes an enlightened philosopher, "let us carefully distinguish those effects which belong to the chemical, from those which depend upon the vital power, and we shall then be in the right channel for obtaining an insight into the latter. By this method of investigating Nature, we shall arrive at a clear comprehension of the metamorphoses which the aliments undergo in the living body, and of the action of remedies."

Liebig.

Rapidity of these changes.

It may here be noticed, the remarkable *rapidity* with which changes are produced in the blood, and which is so manifest in the development of many diseases. The short space of time that is required to contaminate the whole mass by the inhalation of *miasmata*, and by the inoculation of some specific diseases, has in this respect a strict analogy to the process of fermentation, or the sudden decomposition of organic substances after death.

Symptoms and Diagnosis.—Though we may not be able to discriminate the symptoms of those functional disturbances of the heart which are caused by changes in the blood's qualities, it is of primary importance to distinguish them from those which are the effects of an increase in its quantity, or from morbid changes in the heart's tissues. That such discrimination is no easy task there cannot be a more convincing proof than the numerous errors in *diagnosis* which are daily committed, and the dubious opinions so frequently given by intelligent observers.

The physiological symptoms.

The physiological symptoms of the disturbances of the heart caused by changes in the blood, are such as may be anticipated would arise from the different systems of the economy being supplied with a vitiated blood.

The influence of an unhealthy blood has a powerful effect on the *cerebro-spinal* system. The intellectual powers become in most instances excited, the mind irritable, and sleep imperfect or interrupted; but when an excretion, such as bile, has been reabsorbed and mixed with the blood, the mind becomes sluggish and inert, and there is general debility and emaciation.

The functions of the *respiratory organs* will depend on the changes in the blood that are caused by errors in the incrementitious and in the excrementitious processes of the digestive und cutaneous systems, as in either case the lungs will be required to assist in performing the imperfect functions of these organs.

The condition of the *digestive organs* will greatly contribute in assisting a correct *diagnosis* to be formed of the nature of the disorders of the heart's functions; and, as I formerly observed, those generally who have an organic affection of the heart have seldom the digestive organs much deranged; so when these are disordered along with a derangement in the heart's functions we may suspect that the affection of the heart is sympathetic.

The *cutaneous system*, from its connexion with the heart, must necessarily participate in its diseases. Accordingly, we find that in the functional diseases caused by changes in the blood, the cutaneous surface exudes a vitiated perspiration, becomes pale and bloodless, or, as in the *morbus ceruleus*, the skin acquires a deep crimson hue.

The anatomical symptoms.

The anatomical symptoms of the disorders of the heart's functions from changes in the blood demand an attentive scrutiny, the more especially as these are so apt to be mistaken for the symptoms of some organic mischief.

In most cases both the *impulse* and the frequency of the heart's contractions are increased, and sometimes the force is so much augmented as to cause the pulsations to be perceptible to the patient.

To express a beating of the heart sufficiently intense to be felt by the patient, the term *palpitation* has usually been employed, and great confusion has arisen in systems of nosology, from this *symptom* having been adopted as a generic term, and comprised under it many different disorders of the heart; just as *headache* has been used to denote not only a symptom, but a *genus* of disease.

Cullen's Nosology.

Palpitation is indeed so common a symptom, that few affected with a disordered heart have not, at one time or other, suffered from it,—an increase in the heart's impulse being a frequent indication both of organic and functional diseases.

The disturbances that take place in the heart's functions from changes in the blood, are in many instances accompanied with changes in the *sounds;* and this may be anticipated when we recollect that as the sounds depend upon the currents of the blood passing through the heart's cavities, any change in its function which alters the currents must necessarily change the sounds. On this principle I would account for the "bellows sound" so often observed in anæmia, caused from excessive hæmorrhage, and also in chlorosis. But the "bellows sound" in functional disorders of the heart must be estimated as a diagnostic sign with great caution, as it is met with in many very different morbid conditions of the heart, so that no certain conclusion can be drawn from its presence. In forming a diagnosis, special care must be taken in each case to view the whole assemblage of symptoms, physiological, as well as anatomical, by which alone we can be enabled to refer the morbid sound to a functional or to an organic disease.

"The different signs furnished by auscultation in order to distinguish an organic affection of the heart, may be manifested when no such affection exists. On the other hand, it is no less certain that the affection may be very grave, and nevertheless it cannot be revealed by auscultation."

Andral.

The permanency of the symptoms is an important diagnostic character; for in the disturbances of the heart's functions, where there is a change in the blood, there is necessarily an unceasing interruption of the circulation; whereas, in symptomatic affections the symptoms vary exceedingly in their intensity and duration, and even cease altogether for a certain time, assuming a paroxysmal character.

Prognosis.—In no diseases is a correct prognosis more desirable than in those of the heart; for whenever the attention of a patient has been directed to the condition of this organ he becomes extremely anxious to know not only the probable results, but the nature of the disorder,—whether it be organic or merely functional; and I have already pointed out the line of conduct which the practitioner should pursue in the moral treatment of the sick. See page 281.

The functional diseases which we have now been considering, however severe and alarming they may sometimes become, are yet seldom of a dangerous character; and many people pass through a long life suffering from such affections, ultimately perishing from some malady unconnected with the organs of circulation.

Treatment.—So numerous being the changes to which the blood is liable, we see how important it must be in the treatment of those disturbances of the heart depending upon such changes to be able to detect what are the organs or system of organs which cause the alterations in the qualities of the vital fluid; for to such organs ought the chief remedial means be directed.

The management of the digestive organs must always be of primary importance, commencing with such means as will contribute to the formation of good chyle,—a judicious system of ***dietetics.*** From the constant changes in the blood which derangements in the incrementitious and in the excrementitious processes create, must arise those varied feelings of health and of mental and bodily activity which we all daily experience. Hence the importance of regulating the diet, and the power we have to preserve both mental and corporeal vigour.

As the *fibrine* is abundant in proportion to the strength of the body, so in the treatment of those diseases where there is that feeble state of the frame which indicates a diminution of fibrine, we can supply the system with the kind of food which contains a large proportion of that constituent of the blood.

Of no less importance will be an appropriate use of ***stomachics, hepatics,*** and ***purgatives;*** and their administration should be conducted according to the principles which have been already pointed out, and by an attentive discrimination of the peculiarities of each case. See chap. viii

There are also changes in the blood, which can be corrected by *diuretics* and by *dermotics*, the mode of administering which has also been explained.

Besides the means necessary to improve and regulate both the incrementitious and excrementitious processes, those medicines which change the constituents, or which correct any vitiated conditions of the blood, are essential auxiliaries in the treatment of the heart's functional diseases; and although the operation of particular medicines cannot be explained, yet experience has taught that some functional aliments of the heart, produced by changes in the blood, are relieved by particular medicinal substances. Thus the curative effects of the *alkalis*, and of *iodine*, as well as of some vegetable substances, as *sarsaparilla* and *dalcamara*, *cinchona*, in gouty, rheumatic, syphilitic, and scrofulous affections, and the benefit of preparations of *iron* and *copper*, in chlorosis and anæmia, are all perfectly established.

But the vitiated elements in the blood which constitute diseases not having been revealed, it could not be anticipated that Therapeutic agents could have been suggested by which the unhealthy ingredients which the blood might contain could have been decomposed or rendered harmless; and when we reflect how exceedingly minute are the quantities of matter by which the blood may be changed, and how incomprehensible are the processes of the vital laboratory, it need not be wondered at that a knowledge of the nature of such noxious ingredients in the blood should have been found beyond the reach of human investgation.

In fine, though we have legitimate grounds for rejecting the hypothetical doctrines of Boœrhaave, and the untenable notions which the humoral pathologists entertained of an alkalisency, acidity, acrimony, and putrescence of the fluids, it must be acknowledged that even up to the present day neither physiological nor chemical science have been able to explain the true nature of the changes which the blood undergoes both in health and in sickness.

Although the altered state of the blood may have been the primary cause of a disordered action of the heart, it also happens that the interior surface of the heart's parieties sometimes becomes more or less irritable, so that *neurotics* should in such cases be given, in order to allay the irritability of the *endocardium.* For in like manner as an alkaline medicine combined with opium allays both a morbid secretion from the kidneys and an irritable state of the bladder, or that tenesmus, is subdued by opiates, whilst appropriate medicines are given to correct the morbid secretions of the alimentary canal, so will neurotics, especially *camphor, ammonia,* and *hydrocyanic acid,* be advantageously combined with *hæmatics* in the treatment of functional disturbances of the heart.

Much, too, depends on the *air* which we breathe; for as I have already mentioned, notwithstanding the atmospheric air contains the same proportion of oxygen and nitrogen in all situations, yet there are other elements which, although they have not been defined, undoubtedly exist, and have a great influence upon the animal œconomy.

See page 459.

In the treatment of functional disorders of the heart, we ought not, therefore, to neglect the benefit which may be derived from the changes on the vital element which are produced by *climate.*

"The national character and the mere grave and gay dispositions of men are dependent, in a very high degree, on climatic influence. The poetry of the Greeks, and the ruder songs of the primitive northern nations, owe great part of their peculiar characters to the aspect of the plants and animals seen by the bard and the mountains and valleys which surround him, and to the air which he breathed."

Humboldt's Physiognomy of Plants.

When the functions of the heart have been disordered from the blood being changed, there must sometimes be more or less difference in the *quantity* contained in the heart's cavities; and in such cases great benefit will be derived by the abstraction of a small quantity of *blood* by leeches, from the precordial region. Should even the quantity of blood within the heart not be greater than what is required for health, yet that quantity may be superabundant in disease, so that the abstraction of a portion of it would be useful.

The employment of *bloodletting* in cases of this description is, indeed, a nice point to determine. But whenever the propriety of the measure becomes a matter of doubt, it is generally a safe rule to adopt the depletion, the application of a few leeches not being likely to do much harm; whereas the loss even of a small quantity of blood may be essentially beneficial.

There is one symptom in the maladies which we are considering, which I would venture to affirm seldom fails to point out the propriety of abstracting blood. Whenever a spontaneous hæmorrhage has taken place from the æthmoidal, from the pulmonary, or from the hæmorrhoidal vessels, it may be considered as an effort of the *vis medicatrix* to relieve congestion, and in such cases the application of one or two leeches to the precordial region will seldom fail to assist in relieving the heart. "My son," says Wierius, "while at Bologna, pursuing his studies, had this afflicting *palpitation*, accompanied with a capricious, frequent, and intermitting pulse; but by bleeding, which the older physicians never neglected, and care, and relaxation from his studies, he got quite well."

On the other hand, serious mischief has often arisen from the improper use of bloodletting; a tumultuous action of the heart and uneasy sensations in the head, produced by a diminished proportion of *arterial* blood having often led the incautious physician to abstract blood, the effect of which has been to lesson in place of adopting those means which would increase the action of the heart. Morgagni.

CHAPTER XXIII.

FUNCTIONAL DISEASES OF THE HEART FROM DISORDERS OF THE NERVOUS SYSTEM.

Phenomena and causes of the nervous affections of the heart; they arise either from disturbances in the nervous centres, or in the ganglionic nerves; general character of these two classes of nervous affections; affections of the heart caused by diseases of the cardiac nerves; these nerves are both sensory and motor; illustrated in angina pectoris and palpitation; pathological inferences; affections of the heart caused by disturbed associations of the nerves of the ganglionic system; their physiological and anatomical symptoms; diagnosis and treatment; the sympathetic affections; their symptoms, diagnosis, and treatment.

General observations.

Hitherto our inquiries have been directed to those diseases in the heart's functions which are produced by changes in the quantities and in the qualities of the vital fluid; but there remains to be considered another class of functional disorders, which depend upon the influence of the *nervous system*—an influence which is exercised on the heart either directly by the cerebro-spinal nerves, or through the medium of that sympathy which subsists between the heart and the other organs with which it is associated by the ganglionic nerves.

Two classes of the nervous affections of the heart.

Derangements in the heart's functions from diseases of the nervous system may be therefore, it appears to me, with propriety subdivided into two classes.

In the *first* class, the action of the heart is deranged by the morbid conditions of the nerves of the cerebro-spinal system; and in the *second* class, by disturbed associations of the nerves of the ganglionic system.

Bichat 'Anat. Générale.'

This arrangement, I think, will be found practically useful, and not inconsistent with physiological science; for, though some may not admit that there are two distinct systems of nerves, and that the ganglionic is not independent, but is subordinate to the cerebro-spinal system, yet, in a pathological point of view, they may be considered as separate and distinct; diseases in the one taking place from the great nervous centres, and communicating directly with the heart; and in the other arising from the relation which subsists between the cardiac nerves and those viscera which are supplied by nerves of the ganglionic system.

But, whilst admitting this division of the nervous system in our pathological inquiries, we must not lose sight of the intimate relation which subsists between the cerebro-spinal and ganglionic nerves; a relation which is established by the ganglionic system being formed by nerves from both of the great nervous centres: and it is by this relation that we can explain the phenomena of many of the nervous diseases of the heart.

See Chap. VIII. Influence of the cerebro-spinal system,

I have already endeavoured, at some length, to point out the effects of derangements of the *cerebro-spinal* system upon the heart, and to show that the consent of these two vital organs depends on both the connexion which subsists between the heart and the brain, in virtue of nervous filaments, and by the influence of the blood on the cerebro-spinal system.

and of the ganglionic system.

The disorders of the nervous system which disturb the functions of the heart, may arise either from some primary affection of the *cerebro-spinal* nerves, or of the *cardiac nerves;* these being derived from the ganglionic system.

See page 110.

The influence of mental emotions on the heart's functions have already been fully explained; in all the diseases of the brain and spinal cord, various changes being produced in the functions of the heart.

and of the cardiac nerves.

Influenced, as the actions of the heart must be, through the medium of the nervous filaments which come from the brain, like other organs it also has its special nerves, the various conditions of which all influence its functions; and, whilst the cardiac nerves regulate and control the actions of the heart, the heart, in its turn, when its functions are deranged, disturbs the cardiac nerves.

The cardiac nerves are both sensory and motor.

The progress that has been made in physiological science may essentially contribute to assist our investigations on the pathology of the cardiac nerves. For, as it has been observed, that in diseases of the spinal cord the sensory and the motor columns are separately affected, so it will be found, that in one class of the nervous diseases of the heart, the *sensory*, and in the other the *motor*, nerves are disordered.

The morbid condition of the *sensory* nerves are characterised by uneasy sensations and pain; and when the *motor* nerves are affected, there is an inordinate muscular action, of which phenomena we have striking illustrations: of the first, in the *angina pectoris*, and in the second in *palpitation*. At the same time, it should be noticed, that both systems of nerves may be affected in particular examples of disease, as is often observed in the nerves of other organs.

Morbid sensations of the cardiac nerves.

The first class of these affections of the cardiac nerves, or of their *sensory* branches, are a feeling of anxiety and uneasiness, sometimes amounting to severe pain, in the region of the heart, frequently extending along different branches of the nerves of the chest, neck, and usually the left shoulder, from whence they extend down the arm. The degree of pain, however, which those suffer who are afflicted with a disease of the heart, is not always to be taken as a just criterion of the extent or danger of the malady, many lingering ailments having no influence on the *sensory* nerves.

Angina pectoris.

The painful sensations to which the name of *angina pectoris* has been given is a vague term, like that of palpitation or headache, being employed to signify a distinct disease; whereas, it merely expresses some nervous symptoms which are common to many of the heart's maladies. There is, indeed, no affection of the heart the pathology of which has been rendered more obscure than *angina pectoris;* a confusion which has arisen not only from the symptoms having been attributed to very different morbid conditions of the heart by different observers, but also from all those symptoms which are described as appertaining to angina being met with in many organic as well as functional diseases of the central organ.

Consult the writings of Parry, Jenner, Heberden, Morgagni, and Haller.

That such an assemblage of symptoms should be always caused by a change in the structure of the *coronary* vessels, to which angina has been generally attributed, is not the case; for there are abundant proofs of these vessels being greatly diseased, and not accompanied with neuralgic symptoms. And there are also other diseases of the heart's apparatus, such as of the valves, where no alteration had taken place in the coronary arteries; notwithstanding which, there were present all the symptoms of angina pectoris. We may therefore legitimately conclude, that as the symptoms of *angina*, each and all of them, appertain to many morbid changes in the heart's structure, in which the cardiac nerves are involved, the name is inaptly employed to designate a disease of any particular tissue of the heart. The only circumstance which can be adduced to corroborate the opinion, that the painful feelings in the cardiac nerves are caused by an ossified state of the coronary arteries, is the juxtaposition of these vessels with the cardiac nerves throughout their whole course: for the cardiac nerves not only accompany the arterial trunks, but "they pass into the muscular parietes of the heart along with the coronary vessels; and the nervous filaments can be traced as far as the third, or even the fourth subdivision, of the arteries. Here we lose sight of them even in the hearts of the largest animals."

Bichat 'Anat. Des.'

Consistent with these views of the nature of the nervous affections of the heart, and of the misapplication of the term *angina*, I will avoid entering upon a lengthened detail of those symptoms which have been described by different authors as constituting *angina* a particular disease of the heart; and these symptoms will be mentioned in the account which is given of the different diseases in which such symptoms are manifest.

As regards the *treatment* of neuralgic pains of the heart, I have only to observe that, besides the administration of such remedies as may be required to subdue that state of the heart, of which the painful sensations are the symptoms, those *neurotics* should at the same time be given which act on the *sensory* nerves, such as *chloroform, hydrocyanic acid*, and *digitalis* It is in such cases where the *galvanic electricity* has been extolled by Laennec.

See chap. XVIII.

Morbid actions of the heart's muscles.

Next let us consider those functional disturbances of the heart which depend upon a morbid condition of the *motor* nerves; for, as I have already observed when alluding to the cardiac nerves, either the sensory or the motor branches may be separately affected in the diseases of the central organ.

See page 471.

The heart, like other organs, such as the stomach, the intestinal canal, or urinary bladder, often becomes extremely irritable, by which its contractions are increased both in number and in force. This irritability may arise, as I have already shown, either from the excessive stimulus of a vitiated blood or from an irritable condition of the heart itself. "For the irritability of the muscular fibres of the heart is influenced by the nerves, as those of other muscles are by the nerves distributed on them." See page 156. Portal.

The increase in the number and force of the contractions of the heart points out the system of nerves which is affected; for, inasmuch as those of *neuralgia* characterise a disordered condition of the *sensory*, so do changes in the *motions* of the heart point out the state of the *motor* nerves. And pathological phenomena are quite sufficient, without the aid of the knife of the anatomist, to prove that nervous filaments from the motor column, as well as filaments from the sensory column of the spinal cord, must be distributed on the heart. The morbid condition of the motor nerves of the cardiac plexus must therefore be the direct cause of all the changes which are observed in the heart's impulse, and the spasms and convulsions with which it may be affected.

Changes in the heart's impulse.

Whether the muscles of the heart be morbidly excited by the cerebro-spinal, by the cardiac, or by the ganglionic nerves, the changes in the *impulse* must be always of the same character, so that when the beatings of the heart are so intense as to be felt by the sufferer, the term *nervous* palpitation has been aptly applied.

There is no more frequent symptom in the functional disorders now under consideration than an increase in the heart's *impulse*, and this is sometimes so much increased that the movements of the heart are perceptible not only to the patient, but cause a motion of the parietes of the chest visible to an observer. However, the impulse of the heart may be very considerably increased without being felt, and often it can only be perceived by the patient when he is in the horizontal posture. The feeling of palpitation ought not, therefore, to be always taken as a measure of the intensity of the impulse; as that may, to a certain degree, depend upon the sensibility of the heart itself, or of the contiguous parts of the chest.

Even though there be no distinct palpitation in nervous affections of the heart, there is frequently a fluttering or throbbing sensation in the chest, accompanied sometimes with uneasiness and a distressing feeling of depression approaching to fainting.

The palpitations which accompany these nervous diseases are very irregular and variable in duration, sometimes continuing only a few minutes, and frequently for several days. This, contrasted with the permanency of the increased impulse in many *organic* diseases of the heart, is a useful diagnostic character; for, though palpitations may sometimes take place in a paroxysmal form in organic diseases, in them the fits are usually brought on by some mental or bodily excitement.

Changes in the arterial pulse.

During a paroxysm of palpitation the *arterial pulse* undergoes a corresponding change with that of the heart, becoming rapid and tumultuous, but easily compressed, and sometimes the pulsations of the large arterial trunks are perceptible even to the patient, especially those of the carotids and abdominal aorta. The throbbing of one of the temporal arteries in the common "bilious headache," from excrementitious matter lodged in the alimentary canal, is a striking illustration of the sympathy which subsists between the digestive organs and particular portions of the arterial system.

From similar causes, the action of the heart sometimes becomes very irregular, creating great anxiety to the sufferer, an intermittent pulse having been frequently considered as a symptom pointing out an organic disease.

Changes in the sounds.

The *sounds* in nervous affections of the heart vary both in their duration and intensity, and when it is considered that such changes must be the effects of corresponding changes in the currents of the blood, not produced by changes in the heart's apparatus, but by irregularities in its actions from nervous irritation, it will be readily understood how varied must be the character of the sounds.

Both the sounds may become more intense, and they are sometimes sufficiently audible to be perceived by the patient.

"Sanctius Velasco, son of the Count Velasco, had a palpitation of the heart so terrible, that I and many bystanders often heard it distinctly, *as if a stone had been plumped into a jug half full of water*. Yet this boy got entirely well."

Morgagni.

"In nervous palpitations, the first impressions which the ear receives, when applied to the cardiac region, show that the heart has not acquired greater dimensions. "The *sounds*, though clear, do not extend over a greater space; and the *shock*, though at first it appears violent, afterwards there is but little impulse, for it does not elevate the head of the observer. This last sign appears to me the most important and the most certain of all, taking along with it the increased frequency of the pulsations, and which are generally from 84 to 96 in a minute." Læennec.

The "bellows" sound is met with in those changes in the heart's action, which take place during a hysteric paroxysm; but this morbid sound vanishes soon after the attack. And here it may be remarked, how difficult it is to form an accurate diagnosis from the anatomical symptoms, the "bellows" sound being met with both in organic and functional diseases.

This morbid condition of the heart is frequent in young people, especially about the age of puberty, in those of a nervous temperament, and in those who are exposed to great mental excitement.

Imperfections, both in the functions of incretion and excretion, also predispose to these nervous affections of the heart, and, as has been already observed, the movements of the heart become very tumultuous when there has been a diminution in the quantity and in the quality of the vital fluid.

There are, however, organic affections which are observed chiefly in young persons, and are the effects of measles, scarlatina, small-pox, diseases which are seldom met with in those advanced in life. Whilst men, and those in advanced years, are most liable to organic affections of the organs of circulation, the young, especially those of the nervous temperament, are most subject to diseases of the nervous system.

Treatment.

The *treatment* of the nervous affections of the heart must, in accordance with the pathological views I have pointed out, necessarily vary according as they are caused by diseases of the nervous centres, of the cardiac nerves, or are symptomatic of disease in those organs which are supplied by the ganglionic system.

The irritable state of the heart, which is accompanied by an increase of its impulse, whether or not it be perceptible to the patient, is to be tranquillized chiefly by the exhibition of *neurotics*. The diluted hydrocyanic acid, belladonna, digitalis, valerian, camphor, and chloroform, will each be found useful in particular cases.

Case.

Decided benefit will often be derived from the *hydrocyanic acid*. A youth has passed many sleepless nights from a palpitation which he felt whenever he lay in the supine posture. Three minims of the dilute hydrocyanic acid of Scheele never failed to produce a calm and uninterrupted sleep.

Orange-flower water is in common use as a soporific, and in many instances, when the heart has been too much excited, it is beneficial in procuring *sleep*.

Belladonna is often of great use when applied as a plaster, either upon the region of the heart or between the shoulders.

The shower-bath and sponging over the trunk of the body and arms with cold water and vinegar, or common salt, are also useful remedies.

In almost all cases where the action of the heart has been disturbed by nervous excitement, the blood itself being unhealthy, great benefit will be derived from *hæmatics*, of which the salts of iron, copper, and zinc have long been held in repute.

The condition of the digestive and genito-urinary organs also demand particular attention, and the mode of administering the medicines which are employed in the diseases of these organs has already been explained.

See chap. XIX.

In spasmodic affections of the intestinal canal, it is well known that its contents are with difficulty expelled, even with the assistance of drastic purgatives; whereas, if the spasm be first relieved by a neurotic medicine, the bowels are then enabled to evacuate their contents. And if during parturition the uterus be affected with violent spasmodic pains, the administration of large doses of opium, by allaying the pain, promotes the natural process of expulsion. It is the same as regards the heart; and in those affections where the heart's action has been extremely increased, the circulation should first be tranquillized by a *neurotic*, after which those medicines may be employed which improve the condition of the digestive organs.

When considering those functional diseases of the heart, where there is an increased quantity, and wherein the blood's qualities are also changed, I have pointed out the advantages which are to be derived, and the rules which should be followed in the use of *bloodletting.* See chap. XIX.

It is in the nervous affections of the heart in which this powerful therapeutic measure has produced such mischief.

"A boarding-mistress, having a slight palpitation of the heart, was bled, with some appearance of relief; but after two days her palpitations returned with such violence, the breast seemed at every stroke to be lifted up; she had withal pain, fever, and difficult breathing. They continued bleeding her first in the arm, which did no good; then in the foot, which was absolutely fatal; for, in an hour after, she died, the pulse becoming quicker instantly, and falling gradually lower and lower, and giving less resistance to the finger till she expired! In her viscera, both of the belly and of the thorax, every thing was entire, sound, and natural." Morgagni.

Sympathetic Affections.—Having given a general view of the disturbances of the heart which depend upon the influences of the nervous centres, and cardiac nerves, both sensory and motor, we have still to consider the functional disturbances which are caused by the influence of diseases in those organs with which the heart sympathises, and which are supplied with nerves of the ganglionic system. It may however be observed, that although sympathetic affections of the heart are caused by diseases in the organs of organic life, yet it must not be concluded that the diseases of these organs will always be followed by disturbances in the heart; for in one person the heart, in another the brain, and in another the alimentary canal, may be deranged by some disorder of the stomach.

The sympathetic affections of the heart form a most important class of its functional diseases; for, not only do they frequently occur, but they often assume such a character as to alarm the sufferer as well as perplex and mislead the physician.

Of the sympathetic affections caused by diseases of the organs with which the heart sympathises, the most remarkable are those which arise from disorders of the digestive, the cutaneous, the genito-urinary, and the capillary systems, all which are supplied by ganglionic nerves. As, therefore, the heart is also supplied with *nerves* of the *ganglionic* system, and as that system derives its nerves from several *cerebral* as well as from the *spinal* nerves, we can explain how disturbances of the heart are caused by *sympathy* as well as by the influence of the mind.

Symptoms and diagnosis.

I have already endeavoured to point out how difficult it is in many instances to discriminate primary affections of the heart from those of the *lungs*, in consequence of the intimate relation which subsists between these two vital organs, a relation which is established not only from their vascular connexion, but likewise from both organs being supplied with nerves of the ganglionic system. It may therefore be anticipated, that the functions of the lungs would suffer during an attack of nervous palpitation; and it is in virtue of the nervous as well as of the vascular connexion between the heart and lungs that we can explain the condition of the organs of respiration and circulation in asthma, and in some diseases of the heart, where there is much embarrassment in breathing.

Page 136.

Diseases of the *digestive* organs often cause a derangement in the functions of the heart, a subject that has already been considered at some length. Functional disturbances of the heart are frequently caused by particular kinds of food, or by undigested food, and likewise by medicinal substances; so that it is of importance always to inquire into the existence of any such causes as the true nature of the disease will thus be ascertained.

Case of an eminent physician.

"Early one morning I left town, having partaken of scarcely any breakfast. About two o'clock a fellow-traveller offered me part of a cold mutton-pie, and a few minutes after I had taken it I was seized with a violent palpitation of the heart and intermitting pulse. I returned home in about a week, still suffering from palpitation of the heart. In getting off from the top of the coach, my foot slipped, and I fell backwards head foremost to the ground, without sustaining any injury. The palpitation which I had felt just before the accident ceased for several hours. It did not finally leave me for more than a fortnight."

Besides sympathetic affections of the heart produced by disorders in the alimentary canal, another class of disturbances are caused by changes in the *portal* system, all the symptoms of which are referrible to the right heart.

Although the position of the heart is changed by its natural movements, and though in the various tribes of animals there are peculiarities of structure to enable it to vary its position in reference to their habits, and without disturbing the circulation, yet in man the heart's functions are frequently disturbed by a change of its posture, caused by an over-distended stomach. The effects of a large meal before going to bed in disturbing sleep, and many of the uneasy feelings from flatus, are well known to be caused by the overloaded stomach pressing upon the heart.

The influence which the *genito-urinary* organs exercise on the heart is very remarkable, and that influence may be caused, either by the direct agency of the brain, or by the sympathy which subsists between the heart and these organs of organic life. In all nervous affections of the heart, the quantity of the urinary secretion is more or less increased, and the only change in its constituents is a larger proportion of water; a state of the urine which has always been considered a useful diagnostic symptom.

The uterine system.

There are no sympathetic affections of the heart more frequent than those which arise from derangement of the *uterus*. If the menstrual flux be interrupted, the circulation becomes disturbed, and the heart's functions are no less influenced when that discharge is morbidly increased, or when it comes on at an improper period. Hence irritability of the heart so frequently occurs towards the age of puberty, and previous to or during the menstrual flux. It is this influence of a disordered uterus on the heart which causes many of the more remarkable symptoms of the hysteric paroxysm, the change in the heart's functions producing syncope, and deranging the functions of the cerebro-spinal system, which disturbances of the circulation the economy restores by the vomiting and convulsions so remarkable in hysteria.

During *pregnancy* the functions of the heart are likewise, in many instances, very much disturbed, and to this are to be attributed the nausea and paroxysms of vomiting which often accompany pregnancy, and which are relieved by moderate depletion, along with the use of those remedies that tranquillize the heart.

The cutaneous system.

The influence of the *cutaneous nerves* upon the heart is exemplified if these nerves be irritated or excited, as when the skin becomes the seat of pain, or titillation is employed sufficient to cause laughter. In either case the action of the heart is disturbed, and this may proceed even so far as to cause convulsions and death. The influence of the cutaneous capillaries upon the heart we see illustrated in the effects of extreme cold or heat; these, by interrupting the functions of the capillaries, disturbing the functions of the heart: and in all febrile diseases, whether idiopathic or symptomatic, the heart's action is more or less increased during their acute or inflammatory stage.

The physiological symptoms.

Those nervous affections which are properly considered *sympathetic*, are accompanied by symptoms derived from the organ that is *primarily* affected.

When the action of the heart is deranged, and accompanied by a disordered state of the *digestive* organs, there is no class of symptoms more characteristic of the disordered circulation being *sympathetic*, than a derangement of the alimentary canal. For, as has already been observed, most persons suffering from an organic affection of the heart, have little disturbance in the functions of the alimentary canal; so that the presence or absence of such ailments assists in distinguishing sympathetic from organic diseases of the heart.

Diagnosis.

When we consider the difficulty of discriminating the functional from the organic diseases of the heart, how much more difficult must it be to distinguish the functional diseases from one another. For as the quantity of the blood is constantly changing, and its qualities are never the same, in health and in disease, and as the functions of the heart are also disturbed by the varied influence of the nervous system, the causes which disturb the heart being so multiplied, must produce such an endless combination of symptoms, that it becomes no easy task to distinguish these functional disturbances from one another. "The heart beats 500 sorts of pulses in an hour; and hunted into such continual palpitations, through anxiety and distractions, that fain it would break." Hervey.

When we glance over the various symptoms which accompany the functional maladies of the heart, arising from disturbances in the nervous system, there is scarcely one of them which can be pointed out as pathognomonic of a particular disease; and the physical signs which are present in the functional diseases are also met with in organic affections. There is another reason why the functional diseases which we have been considering are so difficult to discriminate from one another, a difficulty arising from the numerous combinations in which they appear; for the functions of the heart may disturb the cerebro-spinal, the ganglionic, or the cardiac plexuses of nerves, or all these may be simultaneously deranged, and they may be accompanied with changes both in the quantity and qualities of the blood. The age, the sex, the temperament, the history, progress, and duration of the disease, —the condition of the organs of animal as well as of organic life,—all become important diagnostic characters in the sympathetic affections of the heart. The various morbid alterations of the blood, the condition of the organs of incretion and of excretion, the state of the *cerebro-spinal*, the *ganglionic*, and the *cardiac nerves*,—each produce symptoms, many of which are so much alike, that there are numerous difficulties to surmount in forming a correct diagnosis.

The *treatment* of the functional diseases of the heart is perhaps one of the most difficult branches of the healing art. The numerous causes by which they are produced, their combinations with one another, their complication with organic diseases, render it frequently very difficult, in individual cases, to decide on the appropriate remedies, and especially on the order in which they should be administered.

In the treatment of the sympathetic affections of the heart, our chief attention should be directed to remedy the morbid condition of that organ with which the heart sympathises, and at the same time to tranquillize the excited heart by *neurotics*, or to improve by the exhibition of *hæmatics*, any change that may have taken place in the qualities of the blood.

When the stomach itself has been much deranged, I have frequently observed great benefit derived from an *emetic*,—the vomiting, besides its effects on the circulation, sometimes removing from the stomach undigested food, or evacuating excrementitious fluids.

Mercury combined with *antimony*, or antimony alone, has a powerful effect in evacuating morbid secretions of mucus which are often met with in the intestinal canal, and these medicines have also a powerful influence in correcting the biliary secretion.

The *mercury* should always be given cautiously, for, though in some patients decided benefit be derived from a few doses, yet, if carried further, the heart is rendered irritable. Purgatives are also essentially useful remedies in nervous diseases of the heart, and they must be given according to their effects in removing excrementitious matters from the intestinal canal. It is indeed extraordinary, the excitement which the retention of fæculent matters sometimes occasion on the heart, and the restoration of its healthy condition whenever they are removed. See page 336.

The diseases of the *genito-urinary* system which have so powerful an influence on the heart, may be much relieved by medical treament, and those remedies should be employed which increase, diminish, or improve the qualities of the menstrual flux. Chap. XIX.

CHAPTER XXIV.

THE ORGANIC DISEASES OF THE HEART.

General observations on the organic diseases of the heart—each tissue may be diseased separately, or several may be affected simultaneously; the specific character of organic diseases of the heart; comparative view of the diseases of the right and left hearts; essential differences in the diseases of the pulmonic and systemic hearts; physiological and pathological illustrations; general character of the diseases of the right and of the left heart.

General observations.

THUS far I have given a general view of those disturbances of the heart's functions which are caused by alterations in the *quantity* and *qualities* of its blood as well as those depending upon disorders of the *nervous* system. But the functions of the heart are likewise changed by the various morbid alterations in the different tissues of which it is composed, constituting that subdivision which comprehends its *organic* diseases. See page 112.

In investigating the organic diseases of the heart, I shall consider all those which affect each particular tissue; at the same time, in the heart as in other organs composed of several distinct tissues, there are many diseases which are not always limited throughout their progress to one, but in which a greater number of its tissues are sooner or later involved.

Diseases may likewise affect the same tissue either of one or of both hearts simultaneously, and, though the functions of the pulmonic and systemic hearts materially differ, yet the component parts of each being nearly alike, their morbid changes are equally similar.

Whenever a change takes place in the structure of any portion of the apparatus of the central organ, there must necessarily be caused some hindrance either to the ready entrance of the *venous* blood, to the exit of the *arterial* blood, or the vital stream will be altered in passing through the heart's cavities, from some change that may have taken place in the form of the auriculo-ventricular orifices. Therefore we find that one of the most remarkable effects of a change in the structure of the heart is some change in the distribution of the blood, and this is sometimes caused by a comparatively small structural change, whilst a very extensive disorganisation produces little interruption to the great function of circulation.

Except those morbid changes, which may undoubtedly result from functional diseases long continued, or which are caused by a wound, all the organic affections of the heart, I shall endeavour to show, are decidedly of a *specific* kind, arising either from gouty or rheumatic inflammation, or from exanthematous diseases, as measles and scarlet fever;—and sometimes, though rarely, from scrofula, fungus hæmatodes, and fungus melanodes.

Comparative view of the diseases of the right and left heart.

Reflecting on the numerous diseases of the heart, we are led to inquire, not only into those of its different tissues, but also into the character of those classes of maladies which affect each of the two hearts; and although the elementary tissues which compose both hearts are similar, the muscles of each merely differing in bulk, the endocardium of the left heart resembling the lining membrane of the arteries, and that of the right heart being like that of the veins, we nevertheless find that the diseases of each heart are accompanied with very different phenomena, that the left is far more frequently diseased than the right; and that the two hearts may be considered pathologically distinct from one another.

To comprehend these differences we must refer to the mechanism and functions of the two hearts in the healthy state of the body, and I have already endeavoured to point out at some length in what these differences consist. But whilst a distinct line of demarcation may be drawn between them, still we are never to lose sight of the intimate union of their structures, and of the co-operation in their functions, through the medium of the lungs,—in fact, that they are both portions of one complicated machine, any part of which, when once disordered, must more or less influence the functions which are performed by the whole apparatus.

Page 107.

In many affections of the heart this distinction is well marked; for though, as I have said, the functions of the two hearts are intimately blended, yet the *systemic* circulation may be disturbed without causing much perceptible interruption to the *pulmonic* circulation; and, *vice versâ*, the *pulmonary* circulation may be much changed, whilst that of the systemic heart is comparatively little altered.

The differences in the functions of the two hearts it is essential to investigate, when contemplating their disorders; and no pathological phenomena can be more striking than those which may be remarked when either the right or left heart is diseased.

If there be any disturbance in the *systemic* heart, then we may expect to find either an increase or a diminution in the supply of arterial blood to the different organs; and if there be any disturbance in the *pulmonic* heart, there will not be necessarily a change in the systemic circulation, but a change in some portion of the venous system.

Thus, whenever the left ventricle does not expel the usual quantity of blood, the vigour of all the organs is diminished; but when the pulmonic heart cannot impel the blood with its usual force through the pulmonary vessels, the venous system becomes congested, marked by a livid colour and coldness of the skin, and a congested state of the subcutaneous veins.

Nothing can be more remarkable than this difference in the disturbances of the circulation in the two hearts,—differences which are readily explained by a reference both to their mechanism and functions.

It is very striking to observe a person whose *left* heart only is disordered, and to notice how little apparent change there is in all the vital functions when the body is perfectly tranquil, and when from that disease there is a diminished supply of arterial blood to the various organs. For the support of life, it is extraordinary how small a stream of blood seems to suffice. And when the voluntary muscles are placed in a state of relaxation, as happens when the body is in a supine posture, and the respiration is not hurried, there is generally in such cases very little external character of disease. But when there is an interruption to the circulation of the *right* heart, the congestion of the venous system, though it be increased by every muscular or respiratory movement, still remains permanent, varying only in degree; so that, however tranquil the body may be, there is always a discolouration of the skin from the varicose state of the veins; a subcutaneous serous effusion, embarrassment in breathing, and difficulty in lying in the horizontal posture, from the congested state of the pulmonary capillaries.

Nothing can be more characteristic of the differences in the diseases of the two hearts, than those means which the animal economy employs to relieve the symptoms of each. This we may observe exemplified in the hurried respiration and increased impetus of the heart, when the left ventricle is overloaded, and in the sobbing and sighing and deep inspirations, when the pulmonic heart and venous systems are gorged with blood.

The curative effects of *spontaneous hæmorrhages* also point out differences in each heart. We see how much the portal system and the congested *pulmonic* heart are all relieved by the *hæmorrhoidal* flux; how a congestion of the *systemic* heart is relieved by *epistaxis;* how *pulmo-cardiac* congestion is relieved by *hæmoptysis;* and these different modes which the *vis medicatrix* employs to relieve the pulmonic and systemic hearts from congestion, points out an important law of the animal economy, which we should imitate in the treatment of diseases; to abstract blood from the cardiac region, or æthmoidal vessels, when the left heart is gorged with blood; and from the hæmorrhoidal vessels, when the right heart and venous system are congested.

CHAPTER XXV.

THE INFLAMMATORY DISEASES OF THE HEART.

The phenomena and causes of the inflammatory diseases of the heart; the different tissues which compose the heart may be separately inflamed; hence carditis, pericarditis, and endocarditis; the specific character of the inflammatory diseases of the heart.

Their phenomena and causes.

THE different tissues which compose the central organ of the circulation are subject to inflammatory affections like those of similar structures in other organs. These inflammations generally arise from similar causes, but the phenomena by which they are accompanied are of a distinct character; all of these being derived from the special functions which the heart performs as the central organ of the circulation.

The muscular parietes, the pericardium, and the endocardium, may be each inflamed separately, and hence nosologists have enumerated and placed in one genus, *carditis, pericarditis,* and *endocarditis;* at the same time, like inflammatory attacks of the pleura, of the pulmonary mucous membrane, or of the parenchyma of the lungs, cardiac inflammation, sooner or later, and to a greater or less degree, involves usually more than one, and sometimes all the different tissues of the heart.

These inflammatory affections of the heart are produced by similar causes as inflammatory affections of other organs. They may generally be traced to a sudden chill, as from exposure of the cutaneous surface to, or from breathing, a cold and moist atmosphere, to sleeping in a cold damp bed, to cold and wet feet, and to the sudden suppression of any eruption or purulent discharge, or of the menstrual or hemorrhoidal flux.

Inflammatory affections of the heart are accompanied by a train of phenomena, all of which arise and derive their principal character from changes in the heart's functions. As the blood is neither expelled from its cavities nor received into them when in their healthy conditions, the irritable surface of the systemic heart causes the left ventricle to be excited in a morbid degree by the stimulus of the blood, just as an inflamed eye is irritated by the stimulus of light. Thus, the number of the heart's contractions increase, and as a more rapid stream of the vital fluid is thrown especially into the respiratory and cerebro-spinal systems, respiration is quickened, and the mind becomes restless and watchful, and there are various uneasy and painful feelings in the spinal nerves.

No less remarkable is the influence of an inflammatory attack upon the functions of the right heart, especially on the pulmonary circulation, the increased action of the right auricle, caused by its irritable condition, producing a quickened, hurried, and embarrassed breathing.

As may be remarked of inflammatory diseases in general, those of the heart are almost always preceded by some constitutional disturbance, more especially by a derangement in some of the other organs of the economy. We find also that inflammatory affections of the adjoining viscera, more or less affect the heart, and likewise that it is greatly influenced by moral causes, these rendering it peculiarly liable to inflammation.

Of the predisposing causes of inflammatory affections of the heart, none are more frequent than a disordered state of the digestive organs. Food of an improper quantity or quality, or collections of excrementitious matter in the intestinal canal, and biliary derangements, all equally predispose the circulating organs to inflammatory attacks.

And the same remark applies to the uterine system, derangements in that system rendering the heart, in many instances, particularly susceptible of inflammation.

The specific character of cardiac inflammations.

But of all the predisposing causes of the inflammatory affections of the heart, by far the most frequent are those which are of a *specific* character; indeed, common or idiopathic inflammation; properly so called, I have every reason to believe, very seldom affects any of the heart's tissues; the inflammations to which they are liable being either arthritic or rheumatic, those accompanying exanthematous diseases, or those where there is some hereditary peculiarity in the constitution.

Simple idiopathic inflammation is, indeed, seldom to be observed
any organ, except when it has been caused by wounds or acci-
ıts in persons in perfect health. But even in most of such
es there is some idiosyncrasy—some peculiarity of constitu-
n which the injury as it were awakes, and which, ere long,
ver fails to modify the character of the inflammation. Hence,
h is the almost endless varieties of disease, and so greatly
the characters of local diseases differ in every individual from
condition of his general health, temperament, and consti-
ional peculiarities, that we can seldom observe even two
mples of what may be strictly considered the same disease
ich are in all respects similar; neither do we find, that in
ividuals who have received the same extent of wound, does it
ain the same character for any very lengthened period.

And so it is with the heart; for in the few instances of idiopathic inflammation which do occur, it will be invariably found, that besides the effects of common inflammation, changes sooner or later take place which completely modify the character of the attack; changes all of which are derived from the peculiarities in the patient's constitution, or in the state of his general health.

Inflammatory affections of the heart, it has been already mentioned, may affect either one of its tissues, or all of them may be simultaneously inflamed, the inflammations may be variously combined, or the endocardium of only one of the hearts may be inflamed.

Carditis.

When the substance of the heart itself, or, more properly speaking, its *muscular* structure, is inflamed, remarkable changes take place in the muscular fibres, these becoming soft, pulpy, and apparently quite disorganised; but a suppurative process seldom takes place, the quantity of cellular membrane which is interposed between the fibres being extremely small, and much less in proportion than in any other muscles.

Endocarditis.

Far more frequently do we find the lining membrane of the heart's cavities, and especially that of the left heart, inflamed the inflammation exhibiting a very peculiar redness, and followed by changes in the structure of different portions of the membrane.

Pericarditis.

The external covering of the heart is more liable than its muscular structure to inflammation, though it is by no means so often inflamed as the endocardium. The morbid alterations of structure which take place in both these tissues are alike, and are analogous to those which are met with in other inflamed serous membranes.

But, as in all organs composed of different structures, inflammation, however much it may be limited to one tissue of the heart, soon extends to those which are adjacent; so there is seldom an opportunity of observing, after death, either the pericardium or the endocardium alone in an inflamed state. We have sufficient grounds for entertaining this opinion, by contemplating the phenomena observed in the inflammatory affections of other organs, such as those of the *eye*, where there is the advantage, from the transparency of its structure, of seeing all the changes produced by inflammatory disease. In conjunctival inflammation we can observe a small point of inflammation gradually extend, not only over the whole membrane where it has commenced, but spread more or less quickly, and involve all the adjacent tissues.

Here I may remark, that, however minute may be the changes of structure that we are enabled to detect after death, or to observe in some organs during life, for all practical purposes, such nice discriminations can avail little; the treatment of disease not depending either on the precise part affected, or altogether on its extent, but on that assemblage of symptoms which are created by the disease upon all the systems of the animal economy.

CHAPTER XXVI.

OF THE GOUTY INFLAMMATION OF THE HEART.

General observations on gouty affections of the heart; the imperfect accounts hitherto given of gout of the heart; its frequency; analogy of gout with other specific diseases; phenomena and causes of gout; the tissues liable to be affected by gout; it affects the pericardium and the endocardium; the morbid changes produced by gout; a cretaceous looking matter always deposited in the tissues that have been affected by gout; this matter is either the phosphate of lime or the urate of soda; the blood in gouty patients contains the urate of soda; the metastasis of gout; its hereditary character; symptoms and diagnosis of gout; its treatment.

On gouty inflammation of the heart.

Let us first consider the *arthritic* inflammation of the heart, not only because it is by far the most frequent of all the inflammatory affections of that organ, and most within the reach of medical treatment, but because, excepting some cursory observations made by the older writers, this important disorder has not even been alluded to by those modern authors who have professed to collate compendiums of the diseases of the heart, nor by those who have compiled treatises on gout. It is indeed remarkable, that amongst the numerous species into which nosologists have divided gout, especially Sauvages, who divided it into several kinds, from the particular part of the body where the disease was seated, no mention has been made by him of an arthritic affection of the *heart*. Baillie, whose authority may be fairly taken as an index of the state of pathological knowledge of his time, says, "I think I have seen *one* case of gout in the heart," which is the more remarkable, when we recollect that Baillie was associated with the Hunters; and, from his acquaintance with their museums, must have been familiar with the morbid deposits in the valves and other portions of the serous membrane of the heart,—all which, I shall endeavour to show, are the products of gouty inflammation. Corvisart, in his valuable work on the diseases of the heart, has not even

Baillie's posthumous works.

mentioned such an affection; Laennec has but slightly alluded to this disease; and, though a gouty affection of the heart has been distinctly noticed by Kreysig, yet no author, as far as I know, has given a detailed account of the phenomena of the arthritic inflammation of this organ, of its various symptoms, of the changes of structure which it produces, or of the treatment which it requires.

So constant an attendant of *gout* is a change in the heart's action, from the earliest development of the symptoms, and throughout all the different phases, it seems quite unaccountable how this condition of the central organ should not have arrested the attention of pathologists, and that they should, in those affected with gout, have been satisfied with noticing only the changes in the arterial pulse, without at the same time observing the condition of the heart itself. To me it appears that the influence of gout upon the heart explains many of the phenomena of this disease, which have hitherto been most imperfectly understood, and the superficial manner in which this interesting subject has been investigated is the more remarkable, as I will venture to affirm that a person will seldom be met with, who has ever suffered from gout in its usual form affecting a joint, in whom the action of the heart has not been more or less disturbed, either before, during, or after the gouty paroxysm.

It is indeed surprising, that the changes which have been observed so constantly present in the arterial pulse of gouty persons, should not only have led to examine the state of the heart, but also the changes in its structure after death; for it would have been found that there were changes in the actions of the heart corresponding with those of the pulse, and likewise that all of the alterations in its tissues were analogous to those produced by gouty inflammation in other organs. So frequently, indeed, are such changes to be met with, that the morbid alterations in the structure of the interior apparatus of the heart are, I am convinced, far more frequently the products of arthritic than of any other inflammatory affection.

It is many years ago since my attention was first directed to the effects which gout produces on the heart, from the appearances in the body of a military officer who had for a long time suffered from severe attacks of gout, and in whom I found not only the thoracic aorta, but the pericardium, extensively ossified, and its surface covered with a cretaceous matter;—morbid changes which I shall endeavour to show are usually the effects of and characteristic of arthritic inflammation.

From these considerations, I will therefore endeavour on this occasion to collate such observations as I have been enabled to make on the gouty inflammation of the heart; and I have described the gouty affections of the heart as being *inflammatory*, for, in whatever stage or in whatever degree the heart is affected by gout, we can always recognise its symptoms and its morbid changes as those of an inflammatory disease. In treating of the gouty affections of the heart, I must necessarily give a general view of the phenomena, causes, symptoms, and treatment of arthritis.

Analogy of gout to other specific diseases.

Here I may remark, that the voluminous histories of gout which have been published, have made it appear to be so complicated a disease as to lead to the supposition that it is unlike all other maladies. There is, however, no order of phenomena to be observed in the history of gout which are not to be met with in other specific diseases. Comparing gout with *scrofula* both are observed chiefly to affect particular tissues, both are preceded and accompanied by disorders of the processes of incretion and of excretion, both excrete a matter *sui generis*, both are hereditary, and both may be translated from one part of the body to another.

To scrofula.

No more, therefore, should gout be subdivided into different species than we could with propriety subdivide *scrofula;* for, whether gout assumes an *acute* or *chronic* type, whether it affects one *organ* or one *tissue* of an organ, whether it has been confined to one part of the body or *translated*, whether its attacks be *regular* or *irregular*, whether it be *retrocedent* or *misplaced*, or whether it be *anomalous* or *hereditary*, nevertheless, in all these stages, and in all these varieties and forms, each of which have been considered by nosologists as a distinct species, and designated by a particular name, gout ought to be legitimately regarded as one specific disease, and the different *species* nothing more than modifications or phases of one and the same malady.

It has been such artificial divisions which have led not only to erroneous views of its pathology, but which have rendered the principles of treating gout exceedingly complicated; for we shall find that it matters not, in establishing a system of treatment, how the different forms of the disease may be designated, as they are all examples of one specific ailment variously modified from temperament, constitution, and other peculiarities in each individual, and requiring the same therapeutic means for their treatment.

The tissues subject to gout.

Phenomena and Causes.—Gouty inflammation, like other specific diseases, attacks only particular tissues; and, although it has been from the phenomena of gout affecting the synovial membranes and their superincumbent bursæ that the descriptions of the disease have chiefly been given in cystomatic works, yet arthritic inflammation affects not only the synovial, and the serous, but also the mucous membranes and the skin.

Of the serous membranes we find the pleura, the peritonæum, the membranes of the brain, the capsules of the aqueous humour and crystalline lens, and the vaginal coat of the testes, all affected with gouty inflammation.

Both the *gastro-pulmonary* and the *genito-urinary* mucous, as well as the cutaneous surfaces, are also liable to arthritic inflammation. The mucous membrane of the bronchi, of the pharynx and alimentary canal, the mucous membrane covering the eyeball, as well as that lining the urinary passages, are each subject to inflammation distinctly of an arthritic character, attacking individuals of gouty constitutions, and yielding to a system of treatment so as to leave no doubt of their true arthritic character.

The serous membranes of the heart affected.

Reasoning, therefore, from analogy, and bearing in mind the natural structure of both the pericardium and endocardium, we are led to anticipate, that when gout affects the heart, the inflammation will be seated not in its muscular structure, but in either of these serous membranes.

Morbid appearances.

It can only be after death when we are able to see the characters of gouty inflammation of the serous tissues of the heart; but we can observe the peculiar bright scarlet tint of the inflamed skin covering a gouty joint; and we have also a most favourable opportunity of observing, from the transparency of the organ of vision, all the morbid changes and progress of arthritic inflammation in the iris, and thus comparing arthritic *iritis* with *endocarditis*.

When the eye is attacked with gouty inflammation, besides the peculiarity in the red tint of the inflamed *sclerotica*, the serous membrane which lines the cornea, spreads over the surface of the iris, and extends over the anterior surface of the capsule of the crystalline lens, becomes dull and discoloured from effused lymph, and, if the inflammation has been severe and of long duration, or if the attacks have been frequent, portions of the capsules of the aqueous humour and crystalline lens then become thickened, and in some instançes are even ossified.

Now these morbid changes are precisely those of *arthritic endocarditis* and *pericarditis*, the lining membrane of the heart losing its transparency and polished surface, its various portions, such as those reflected upon the valves, becoming thickened with a cretaceous or osseous matter deposited between its laminæ; and the morbid changes of the pericardium are precisely similar.

Though either of the serous membranes of the heart may be the seat of arthritic inflammation, and though we may not be able to detect during life the precise portion of the membrane which is affected, on examining the hearts of those who had long suffered from gout, the morbid products are in most instances met with in the endocardium, and chiefly in that which lines the systemic heart.

The morbid changes which take place in the pericardium and in the endocardium from gouty inflammation, not only resemble those produced by common or idiopathic inflammation, but there are also changes which may be deemed pathognomonic of gout.

Deposit of a cretaceous matter

Of these the most characteristic is the deposit of an earthy or cretaceous-looking matter, of various degrees of consistence, in those tissues which have been the seat of arthritic inflammation, and likewise in the separation of a similar matter from the blood, by the different excrementitious organs.

In the joints and bursæ,

The deposit of a cretaceous matter in the joints and bursæ has always been considered to be the effect of gout; and whenever the arthritic inflammation of a *bursa* advances so far as to create ulceration of the superincumbent skin,—a process which not unfrequently takes place, to permit the escape of a "chalk-stone,"—a fluid containing the same opaque white matter will often continue to be long afterwards secreted, and to exude from the fistulous orifice in the integuments.

and in the Meibomian glands,

A similar chalky deposit I have likewise observed in the *Meibomian glands*, the palpebral conjunctiva being one of those mucous membranes which is by no means unfrequently affected with arthritic inflammation; and I have likewise observed the surface of an ulcer of the *cornea*, the effect of an arthritic ophthalmia, covered with an opaque, white cretaceous matter.

and upon an ulcer of the cornea,

and expectorated from the lungs,

kidneys, and skin.

Chalk-stones are frequently coughed up from the *lungs;* a cretaceous matter is often discharged from the *kidneys;* and there are instances in medical records where a similar looking matter has been excreted by the *skin*.

"A patient who suffered for several months from a paroxysm of gout, had the entire surface of the body covered every morning with a white powder, as if he had been dusted with flour."

Swideaur.

"Pechlin saw several young men, apparently of the most robust and best habits of body, sweat a kind of 'tophaceous' matter. One of them died before he was forty years of age; and such was the general tendency of his humours to a chalky nature, that whatever he spat or sweated was rendered white, from the abundance of this gypsius matter."

VanSwieton.

A cretaceous deposit pathognomonic of gout.

From these morbid phenomena it therefore appears to me, that the excretion of a cretaceous matter may be considered as a pathognomonic character of gout; and that the chalky or "earthy" deposits so frequently met with in the membranes of the heart may be legitimately considered as the produce of an arthritic inflammation.

Chemical qualities of the cretaceous deposit.

In endeavouring to show the analogy of gouty inflammation of the heart to that of other organs affected with gout, I have made use of the common terms of calcareous, cretaceous, and earthy matter; but it is proper to observe, that recent analysis has shown that some of these concretions consist of the *urate of soda* and others of the *phosphate of lime*.

Urate of soda is also found in the *venous blood* taken from the arm of gouty persons,—an important fact, which not only shows that the excretion of that saline substance may be legitimately taken as a pathognomonic character of gout; but affords incontrovertible evidence of gout being the effects of its presence in the blood, or of a vitiated state of the vital fluid.

Garrod's lectures on the blood.

The metastasis of gout.

There is no more striking phenomena connected with the history of gout than its susceptibility of being *translated* from one organ to another, — an important fact to be kept in mind in the treatment of the disease. It may either be translated from the heart to the extremities, or to the heart from the extremities.

See page 393.

Translated from the heart.

When the heart is suffering from gout, it frequently happens that the symptoms are immediately relieved by the gout being translated to the feet, and such an event may be considered, along with other symptoms, as an unerring diagnostic sign of the arthritic nature of the disease of the heart.

Cases.

A Barrister complained of an uneasy feeling in the region of the heart, and occasional palpitations, during nine years. Pain and redness now affected first the little toe of one foot and the inner ankle of the other foot, and, on the following day, all the uneasy feelings in the chest abated. I saw him six weeks afterwards with a tenderness continuing in one foot, all the unnatural feelings in the chest abated, and a great amendment had taken place in his general health. Baillie mentions having seen a person who had suffered from palpitation of the heart for six months, which suddenly disappeared on the accession of a fit of gout, and Scudamore relates a similar case.

When the local articular inflammation is checked, and altogether ceases, symptoms supervene which point out that the disease has been translated to the heart, or to some other internal organ.

Translated to the heart.

Numerous are the instances of persons, when suffering from gout in the feet, plunging them into cold water, after which the gouty inflammation of the joint suddenly ceased, and was translated to the heart.

Case of George IV.

The circumstances which attended the last illness of George IV., furnish a very distinct history of the more striking features of a gouty affection of the extremities being translated to the heart, and an account of this case cannot fail to be generally interesting, more especially as no correct statement of His Majesty's last illness has been given by any of his medical attendants; whilst it also gives me an opportunity, even at this distant period, of correcting some erroneous statements made for unworthy purposes.*

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* "Essays and Orations read and delivered at the Royal College of Physicians, &c., &c., &c.," by Sir Henry Halford, 1831.

I have formerly alluded to our Royal Family as an example of the hereditary nature of gout, many of them having perished from gouty affections of the chest.

George IV. had often suffered from gout, and luxurious habits of life also rendered the general system plethoric, and very susceptible of inflammatory attacks, the inflammation usually affecting the chest.

To relieve the pain attending the paroxysms of gout, the King had, amongst a variety of other remedies, frequently taken "Wilson's Gout Tincture," and the inflammatory attacks of the chest had often required for their relief copious bloodlettings. His Majesty also had, during many years, often complained of uneasy feelings in the head, which were always relieved by cupping.

The last illness of George IV. may be said to have begun in the spring of 1830; the King having then had a severe attack of inflammation, from which he never altogether rallied.

In the beginning of April His Majesty, as well as those around him, became extremely anxious about his condition, and on Saturday the 23rd of April the King sent to London Lord Strathaven, his equerry, with a message to me, commanding my attendance at Windsor on the following morning.

Not having seen the King for some weeks, I was much struck on entering the bedchamber, with a change in the expression of His Majesty's countenance, which bespoke great anxiety.

The King was sitting up in bed, unable to recline in the horizontal posture, breathing with great difficulty, and with an oppressed and intermitting pulse. All the painful gouty feelings which were in the joints had, for some time, subsided; since which, the difficulty of breathing had supervened.

After a lengthened conversation, in which the King gave a most accurate and detailed account of the progress and symptoms of his malady, "I wish that you, my good friend," observed the King, "would tell me candidly your opinion of my condition,—I can get no satisfactory answers from Sir Henry Halford."

My reply was, "It appears to me, Sire, that the character of your ailments has lately changed, and that, instead of any important disorder being now present in the lungs, the great embarrassment in the breathing arises from a disturbance of the heart; and that this disturbance of the circulation is caused by the gout having left the extremities, and been translated to the heart." On pressing for an opinion on the danger of the disease, which the King did in a firm, manly tone, I replied, "Your Majesty must be quite aware that, when a vital organ is affected, it is impossible to say that there is *no* danger; but I am convinced from the nature of your present condition, much relief may be obtained by medical treatment."

After explaining to the King the proposed mode of treatment, I retired.

Sir William Knighton afterwards requested me to *write* my opinion, both of the nature of the disease with which the King was afflicted, and of the remedies I proposed, in order to be put into the hands of Sir Henry Halford, who was expected at Windsor in the evening. Of that letter the following is a copy:

"Dear Sir Henry,

"The reason of my now writing to you, I will explain on our first meeting.

"It appears to me, that the distressing dyspnœa, of which the King complains, arises from a *disease of the heart*, and I believe that the affection of that viscus depends upon an arthritic diathesis.

"I cannot help being impressed with the opinion, that if the gout would affect the extremities, the heart would be relieved, and, with this view, benefit might be derived by the use of the pedeluvium and stimulants to the legs and feet. Though general depletion be inadmissible, I would expect benefit from the application of six or eight leeches to the region of the heart, and these to be repeated according to the effects produced.

"Believe me yours, faithfully,

"James Wardrop.

"*Windsor Castle, April* 25, 1830."[*]

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[*] "In the case of His late Majesty, the King's Government and the Royal family were apprized as early as *the 27th of April.* (I hold in my hand the original letters which gave the information to the Prime Minister); that His Majesty's disease was seated in his chest, and that an effusion of water into the chest was soon to be expected. It was not,

The King expired on the 26th of June, and the morbid appearances, which were *officially* published, fully confirmed the opinion I had given of the nature of the King's illness.

"Two pints of water were found in the cavity of the right side, and three pints and three-quarters in the left side of the chest. The left lung was considerably diminished.

"The lower edge of each lobe of the lungs had a remarkable fringe, which, upon examination, was found to be formed by a deposit of fat.

"The substance of the lungs had undergone no change of structure; but the mucous membrane lining the air-tubes was of a dark colour, in consequence of its vessels being turgid with blood.

"The pericardium contained about half an ounce of fluid, but its opposite surfaces in several parts adhered to each other from inflammation at some remote period.

"Upon the *surface of the heart and pericardium* there was *a large quantity of fat;* and the muscular substance of the heart was so tender as to be lacerated by the slightest force. It was much larger than natural. Its cavities upon the right side presented no unusual appearance; but those on the left side were much dilated, more especially the auricle.

"The three semilunar valves at the beginning of the aorta were ossified throughout their substance, and the inner coat of that blood-vessel presented an irregular surface, and was in many parts ossified."

Gout translated to other internal organs.

When alluding to the *metastasis* of gout, it ought, however, to be mentioned, that on leaving a joint it is not always translated to the heart, but sometimes to some other organ, especially to the stomach, to the head, or to some portion of the gastro-pulmonary mucous surface.

Its metastasis caused by an injury.

The translation of gout is likewise the consequence of a distant part being injured, or from a surgical operation. When a

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however, *until the latter end of May*, when His Majesty was so discouraged by repeated attacks in the embarrassment in his breathing, as to desire me to explain to him the nature of his complaint, and to give him my candid opinion of its probable termination, that the opportunity occurred of acknowledging the extent of my fears for his safety."—*Orations, &c.*, p. 67.

gouty person receives an *injury*, such as spraining a joint, I have frequently seen instances where the subsequent inflammation has been completely subdued by local bleedings and other depletive means; but soon afterwards an inflammatory attack has come upon the injured part, the rosy-colour of the skin, the accompanying œdema, the hereditary disposition, and the inefficacy of the previous successful system of treatment, pointing out the attack to be of an arthritic character.

Case.

A lady sprained her wrist severely, and the subsequent inflammation required the repeated application of leeches before it was subdued. About six weeks after the accident, and when only a slight tenderness and swelling remained, the wrist, back of the hand, and a part of the fore-arm, suddenly became much swelled, the skin of a bright pink colour, with considerable tenderness. Suspecting from the inefficacy of the former remedies, as well as from the local and general symptoms, that this inflammation was of an arthritic character, I treated it accordingly; all the symptoms speedily yielding to a few small doses of colchicum combined with the carbonate and sulphate of magnesia.

Or by a surgical operation.

The propriety of weighing the necessity of a surgical *operation* on a gouty subject, and of his being in a fit condition before it is performed, are of essential importance for its success; for it has frequently happened that operations have failed from the wound being attacked with gout. This I am convinced has often been the cause of the want of success in lithotomy, and in the operations for the cure of cataract; both urinary calculus, and cataract being common diseases in gouty persons.

Page

Or by medicines.

Effects in many respects analogous to those just mentioned are produced by *medicinal substances*, such as colchicum, which, by quickly subduing the pain and local inflammation of a severe attack of articular gout, the inflammation soon returns, and often in another and in a vital organ; a dangerous effect of such medicines, which may be, to a certain extent, avoided by combining them with those which increase the excrementitious processes of the skin, of the kidneys, and of the alimentary canal.

Case.

A naval officer received an invitation to dine at the Pavilion, and having been seized with gout in his feet, he sent for a physician, requesting him to employ such remedies as would enable him to dine the following day with the King. Accordingly, a dose of *colchicum* was administered, which speedily gave relief, and enabled the gallant admiral to go to the royal feast! In a few days afterwards he consulted me on account of a great difficulty of breathing, accompanied with tenderness in the cardiac region, and the pulse so rapid and unequal that it could with difficulty be counted, leaving no doubt of the arthritic character of the attack, in consequence of the gout having been translated to the heart from the extremities. Though the more severe symptoms of the attack were subdued by antimony, opium, and mercury combined, along with derivatives, yet his health was never restored, and he died three years afterwards of a diseased heart.

Hereditary character of gout.

The *hereditary* nature of gout has been the theme of much comment and dispute; but it may be said of gout as of scrofula and cancer, that there are families who are more subject to them than others; although there are no individuals of whom it could be asserted that they could not have an attack of gout. Many persons, but particularly women, dislike the notion of having a complaint which has any relation to gout, from an erroneous impression that gout is only a disease incident to the votaries of Bacchus and Venus; and though gout, like most other ailments, is aggravated by habits of sensual indulgence, yet it may frequently be observed in those who live very temperately, and who are not able to trace it to any hereditary cause. Indeed we may often notice in the same family the different branches suffer in various degrees from this malady; some being severely afflicted, some more slightly, and others passing through a long life without having had even the most trifling illness of a gouty character.

Symptoms and Diagnosis.—That during the very earliest stage of a gouty affection of the heart *inflammation* is present, we may venture to conclude, from the symptoms and from the morbid products in the more severe cases; for we cannot expect that so slight a degree of inflammation that might materially disturb the heart could be manifest after death, any more than the inflammation in a portion of skin, or of mucous membrane, could be visible, which was quite apparent during life.

When gout assumes a paroxismal type, either the heart continues to be the chief seat of the local inflammation, or, far more frequently, it affects at the same time one or several of the synovial capsules.

If the inflammatory attack be confined to the central organ, then along with all the symptoms of general fever, there is superadded a tumultuous action of the heart. The *impulse* and *rhythm* are changed, the heart palpitates more or less violently, and the beats are increased in frequency, and are often irregular and intermitting. The *sounds* are also changed according to the severity of the attack and the particular portion of the endocardium which is affected.

Changes in the lungs.

The irritable condition of the heart explains the disordered state of the *cerebro-spinal* and *pulmonary* systems which accompany it; for, as I have endeavoured to point out, whenever the action of the heart is changed, the alterations in the circulation necessarily produced in the lungs and in the head, disturb the functions both of the pulmonary and of the nervous systems. And when the inflammation of the heart is of a more acute character, the two vital organs, the brain and the lungs, then become still more disordered; the palpitations, restlessness, irritable state of mind, and oppression in breathing, all being increased.

In those examples of gout, where the disease has been suddenly translated from the extremities to the head, causing *apoplexy*, or to the chest, producing difficult respiration and *asthma*, it is extremely probable, future observers will find that such effects have arisen from gout being translated to the heart, whose disordered functions produce the changes both in the brain and in the lungs.

Apoplexia Arthritica.

Portal, 'Traité l'Apoplixie.'

In the multiplied observations on apoplexy, wherein particular cases are narrated, which were considered to be caused by gout, no allusion is made by any writer, and no one has attempted to trace the symptoms of the disordered brain to a disease of the heart; though in several instances the morbid condition of the heart has been distinctly mentioned. The case of the celebrated anatomist, Malphigi, is one of those of "arthritic apoplexy" wherein the heart was diseased, gouty concretions being found in the *brain*, and likewise "ossification in the valves of the heart."

Changes in the Cerebro-spinal system.

The disorder in the heart's functions explains satisfactorily how, from the changes in the circulation of the cerebro-spinal system, mental irritability and restlessness should be so constantly present in gouty affections of the heart. These effects of a disordered circulation might, indeed, be referred to, in order to illustrate the influence of changes in the action of the heart on the nervous system, and they afford additional proof of those pathological views I have, in a former part of this work, endeavoured to establish. These symptoms likewise afford an additional proof of the errors of those nosologists who have classed such symptoms amongst *nervous* diseases, conceiving them to be primary affections of the nervous system.

The heart is affected with gout in various degrees.

In gouty persons the heart appears to suffer in all possible degrees; for, whilst in many instances this organ is severely affected, in the majority of cases it is only after repeated paroxysms, and after the lapse of many years, that permanent changes have been found in the heart's structure, sufficient to interrupt the stream of blood; and dissection reveals to what a remarkable extent the auriculo-ventricular orifices may be contracted, from repeated attacks of arthritic inflammation, and how life has often been long preserved, by habits of great moral and bodily tranquillity, even after the structure of the circulating apparatus has been materially impaired, and the body supplied with only a very small stream of oxygenated blood. Unless the circulation be disturbed from any accidental cause, and thus life instantly destroyed, those who have suffered from arthritic inflammation of the heart usually perish from the effusion of water in the cavities of the pericardium, pleura, and cellular tissue.

During a prolonged paroxysm of gout, it frequently happens that the joints and the heart suffer alternately, sometimes the one and sometimes the other being under the more immediate influence of the arthritic inflammation; and when the joints become inflamed, whatever disturbance may have previously been in the heart's condition, the cardiac symptoms are now alleviated, or altogether subside.

Heart alone affected.

Besides those persons who have been sufferers from gout in the extremities, and in whom there is no doubt of the connection of the gouty attacks with a disturbed condition of the heart, there are many, and these chiefly women, in whom gouty inflammation appears to affect the heart alone. Indeed, so large has been the proportion of instances of this description, that have come under my own observation, occurring more especially at that period of woman's life when the menstrual flux is about to cease, that arthritic carditis may be considered as a frequent complaint; whilst, from the symptoms accompanying it, such affections have, as I have said, been generally arranged amongst *nervous* diseases.

In women especially.

Though it has commonly been considered that gout is much less frequent in women than in men, this remark strictly applies only to articular gout, or to the more severe gouty paroxysms, wherein the joints are violently inflamed. The frequency of arthritic affections of the heart in women I would account for by the well-known fact, in the history of gout, that any gouty affection of an internal organ is relieved by a paroxysm of articular inflammation; and as men are far more subject to such attacks, consequently, in equal numbers of gouty men and women, a greater proportion of women will be found with a disturbed heart than men; and a proportionably smaller number of women affected with articular gout.

The affection of the heart, in gout, I may observe, does not necessarily come on either from any violent exertion or from any violent mental emotion, causes to which, I have remarked, other affections of the heart can usually be traced. As might be supposed, gouty affections of the heart, from their specific character, arise either from the translation of gout from another part, such as the toes or feet, or this affection of the heart may be preceded by those derangements of the digestive functions which accompany attacks of gout in other organs.

Symptoms arising from a disordered state of the incrementitious and excrementitious processes, always accompany or precede the local inflammation. Such symptoms may precede the accession of any local inflammatory paroxysm only a short time, or they may be alone present for many months, or even years. There are many instances, especially amongst women, where a disordered state of the sanguiferous, as well as of the digestive system, had existed for a long period, without any local inflammation having made its appearance, sufficiently characteristic to establish the arthritic nature of the malady; though doubtless, in such cases, there must have been present an increased vascularity of some portion of one of the serous tissues of the heart, as well as a change in the qualities of the blood.

Gouty dyspepsia.

The condition of the *digestive* organs gives rise to an important class of symptoms, in arthritic affections of the heart, and the deranged state of the stomach which so universally precedes an attack of gout, and is indeed so remarkable during the progress of the premonitory symptoms wherever the local inflammation may be situated, led to the common observation of "gout being generated in the stomach."

There are no symptoms more characteristic of gouty dyspepsia than *acidity* and *flatulency*, and the alvine evacuations are generally irregular, and their quantity and qualities unnatural. The appetite is either impaired, or there is a morbid desire for food, and often to partake of aliments which are disliked during health. Sometimes there is pain in the precordial region, and not unfrequently a sensation of nausea, and sometimes vomiting.

Changes in tongue.

There are appearances of the *tongue* which will be found very characteristic of gouty dyspepsia. Both its bulk and its form are changed. Sometimes it becomes so large as to receive an impression of the teeth of the lower jaw, and instead of being convex it assumes a concave form. The peculiar changes of the colour of the tongue's surface are equally characteristic, the edges becoming of a dull white or slate hue, whilst the central portion is usually covered with a dark brown fur.

A remarkable circumstance in the history of gout, and of which I am not aware there is any analogy in other diseases, is that, when a person who has been long suffering all the symptoms of a gouty stomach, if a healthy condition of the digestive organs be restored, a local arthritic inflammation will then supervene; and so well known is this, that when talking of the sick, it is a common remark, "that he has not strength to bring out the gout."

Case.

An eminent Artist, advanced in years, had long suffered the symptoms of gouty dyspepsia, and also complained of uneasy feelings in the urinary bladder; all which symptoms I was led to consider of an arthritic character. When prescribing antimony and mercury combined, and the sulphate and carbonate of magnesia, I made accidentally the observation, that if he could only have an attack of articular gout, all the present symptoms would be subdued. Much to his surprise, in a very few days he had a slight attack of gout in the great toe of one foot, after which all his former ailments were completely relieved.

Changes in the biliary organs,

The *biliary* organs are generally much deranged, as well as the stomach itself,—the bile becoming of an unhealthy quality, and often diminishing in quantity; changes which are marked by the appearances of the alvine discharge, and the discoloration of the cutaneous surface.

and in the portal system,

Besides the changes in the biliary secretion, there is in many of those who have suffered from repeated attacks of the gout, a congested state of the *portal system*, and which is indicated by the disposition to hæmorrhoids. The connection of the *hæmorrhoidal flux* with gout attracted the notice of the earliest writers, and the relief obtained by the spontaneous evacuation of blood in arthritic affections, pointed out the propriety of artificial blood-letting in the treatment of the disease. The repeated and large quantities of blood which are in many cases thus lost, and the relief obtained,—especially of many symptoms considered as indicating a debilitated system, and likewise many of a nervous character,—show how, under such circumstances, a depletive system of treatment may be adopted.

and in the urine.

The *urine* is much changed in gouty subjects. Those who have suffered from gout are aware of an inflammatory attack approaching when the urine becomes darker and acquires a colour compared to that of English brandy. It usually deposits a thick "lateritious sediment," and is found to contain *urate of soda*, as well as *phosphate of lime;* and the urate of soda varies in quantity before and after the gouty paroxysm. Phosphate of lime is also found in those concretions which are formed in the kidneys as well as in the coats of the arterial system; but this earthy salt has not been detected either in the joints or in the blood of gouty subjects; and it is a curious physiological fact, if that phosphate of lime and urate of soda are both excreted from the kidneys and coats of arteries, but have not been found present in the blood, and that only urate of soda is excreted by the synovial membranes, and found in the venous blood.

Wolleston's analysis of.

In a therapeutic point of view, it is important to recollect that

Majendie.

the proportion of uric acid and phosphate of lime which are contained in gouty urine depend greatly on the food; the quantity of these substances in the blood being increased or diminished according to the quantity of animal food which is consumed,—a circumstance that satisfactorily explains how gout is scarcely known in those classes of society who live chiefly on vegetable food.

And in the skin.

I have already had occasion to remark, that the same saline matter, the urate of soda, was in some gouty people excreted by the *skin;* and I have alluded to persons subject to gout in whom, by increasing the cutaneous excretion by exercise, the gouty paroxysm and all the more severe effects of gout were warded off; so that the excretion of the urate of soda by the skin, besides illustrating an important phenomena, also points out how those medicines which are employed for the relief of gout, and which act upon the skin, separate and evacuate its noxious ingredients.

And in the pulmonary exhalation.

The earthy deposit in the *lungs* of gouty persons also shows how the pulmonary exhalation is contaminated in gouty persons, and becomes a channel for the excretion of vitiated elements in the blood.

Influence of the sanguineous system.

The condition of the sanguiferous system will always be found to have an important influence in arthritis, producing symptoms some of which are referable to the vitiated qualities of the blood, and others to the state of the heart itself.

Page 453.

When speaking of the disorders of the heart caused by changes in the blood, I briefly alluded to those diseases in which the natural constituents of the *blood* were altered in their *proportions*, and to those changes which arise from the *re-absorption* of secreted fluids; but there are also changes in the blood which are caused by the addition of new elements, of which the most striking example which analysis has yet obtained, is the presence of urate of soda in the *venous* blood of gouty people.

Urate of soda in gouty venous blood.

There can be no more satisfactory evidence of this earthy deposit being a pathognomonic symptom of gouty inflammation than that urate of soda is always found in gouty venous blood; whilst the fact of this salt being detected in the blood, likewise shows the important share which the blood must have in the production of gout.

From the morbid changes both in the processes of incretion and excretion which precede and accompany gout, we might have anticipated that there must be important changes in the qualities of the *blood;* and although gouty blood has been found to contain the urate of soda, the *venous* blood has yet only been analyzed, and blood, too, taken from the veins of the arm, so that we are still ignorant not only of the nature of the venous blood in different organs, but also of any noxious ingredients of the *arterial* blood. A knowledge of the vitiated elements which may be present in the arterial blood, might perhaps lead to establish some rational principle for the treatment of the disease, and might likewise enable a satisfactory explanation to be given of the effects produced by those remedies which are considered to be the most beneficial in the treatment of gout. In pursuing, however, our inquiries upon this interesting subject, the chemist should not be satisfied with finding in the blood urate of soda; for it is extremely probable that as *phosphate of lime* has also been detected in gouty concretions formed in the joints, in the kidneys, in the coats of the arteries, and in those membranes subject to gouty inflammation, the same earthy matter, as well as some other noxious elements, may in all probability be also found in the blood.

The arterial gouty blood not yet analyzed.

Admitting that the blood in gout is vitiated, it is legitimate to infer, that such blood circulating through the heart, will be sufficient to account for those disturbances which precede and accompany an arthritic paroxysm,—a condition of the heart which necessarily varies in every possible degree; and as a general remark, it may be said, that whenever the presence of gout can be distinctly traced in any individual, there is always preceding, or along with the disease in the joints, some disturbance in the heart.

Gouty blood disturbs the heart.

Inquiring into the symptoms of gout, whatever may be the organ affected by it, it is essential to discriminate those symptoms which are strictly of an arthritic character from those which are produced by other diseases with which gout may be combined—especially with plethora or rheumatism.

Gout combined with other diseases.

It is the combination of gout with *plethora* which constitutes the gouty paroxysm, and in which may be perceived, in addition

With plethora.

to all the arthritic symptoms, general and local, those also of idiopathic inflammation.

This combination is precisely what may be observed in other specific diseases, as in scrofula, in syphilis, and in cancer, the organs or tissues affected with these diseases being frequently attacked at the same time with an idiopathic inflammation. We may also observe this combination distinctly illustrated when the diseased organ has been wounded, or has received an injury. A scirrhous tumour of the mamma is often accompanied by extensive inflammation and swelling of the cellular membrane surrounding the mammary gland, which inflammation can be relieved by bleeding and other local means, the schirrous nucleus remaining unchanged. So also a contaminated lymphatic gland in the vicinity of a syphilitic ulcer often becomes inflamed from some accidental cause; the idiopathic, or common inflammation thus superadded, yielding to local depletion, whilst the venereal poison can only be afterwards destroyed by mercury. Now, it is precisely the same with gout, the inflammation caused by a blow or other injury upon a gouty joint, is relieved by the local abstraction of blood, whilst the arthritic inflammation requires a very different system of treatment.

Gout and rheumatism combined.

It is no less essential to distinguish the arthritic from the rheumatic symptoms in those cases where gout is combined with *articular rheumatism;* for it is with the rheumatism that affects the joints that this combination may frequently be observed.

Neither is it unusual to find gout combined with *muscular* rheumatism, and in such cases the two diseases are so different from each other that they can even be distinguished by the sufferer, who sometimes describes his ailment as being arthritic and at another as rheumatismal.

Articular rheumatism and gout are, as I will subsequently point out, perfectly distinct diseases, differing in some most essential characters; and there is no feature in their history that has so much contributed to give an impression of their similarity, and of their not being easily distinguishable from one another, as the circumstance of being so often combined in the same person.

Diagnosis of Gout and Rheumatism.

The circumstance of gout and articular rheumatism being frequently combined in the same person, and some of the symptoms being similar, they are apt to be confounded with each other—gout mistaken for rheumatism and rheumatism for gout. There are, however, diagnostic characters which will seldom fail to determine the true nature of each.

Gout has been shown to be the consequence of a long-continued imperfection in the incrementitious and excrementitious processes by which the sanguiferous system becomes sooner or later deranged, and the blood contaminated. But articular rheumatism is caused by external agents, especially by changes in the condition of the atmosphere, such as the exposure of the cutaneous surface to a cold and moist air; and it attacks persons apparently in good health.

The condition of the blood in the two diseases is essentially different; the *urate of soda*, which is present in gouty venous blood, is not found in the blood of those suffering from rheumatism, their blood being remarkable for its proportion of *fibrine*.

Articular rheumatism usually commences in an acute form, and passes into the chronic stage; whilst the phenomena of gout are at first passive, and afterwards assume an acute character.

Muscular and neuralgic rheumatism are equally distinct from articular rheumatism as gout. What can be more dissimilar than the pain which affects a muscle when the part has been suddenly exposed to cold, and a joint attacked with gout? And in neuralgic rheumatism, the character of the pain, and its seat in a nervous trunk, are equally unlike the phenomena of gout.

General observations.

Treatment.—The general principles to be employed in the treatment of arthritic affections of the heart, are precisely the same as those which are most applicable to the treatment of gout in whatever organ the inflammatory attack may appear; all the different species into which Nosologists have subdivided gout being, as I have said, merely phases of one specific disease.

As the premonitory symptoms of gout, especially those of the heart, are generally slow in their progress, and often of long duration before there is any severe inflammatory paroxysm, the treatment of these symptoms becomes of the greatest importance, not only in order to avert an attack of acute arthritic inflammation, but to prevent any permanent changes taking place in the heart's tissues.

The curative indications in gout.

To correct the vitiated condition of the *blood* is a most essential curative indication in gout; and it is not only necessary to discharge from the blood its noxious elements, but likewise to improve the qualities of the incretions by.

The remedies which improve the excretions.

The first class of medicinal substances are those which separate and discharge from the blood its excrementitious matters, either by their action on the digestive canal, on the pulmonary and cutaneous surfaces, or upon the kidneys.

Mercury and antimony.

Of the medicines that act upon the digestive canal, the most powerful are *mercury* and *antimony*. The preparations of mercury and antimony, given singly or combined, have a great effect in evacuating from the alimentary canal morbid secretions, as well as having an influence on the biliary organs, these being frequently deranged.

"Antimony and calomel are both remarkable for promoting mucous discharges, the one as an emetic, and the other as a purgative; and there is a great analogy between their respective operations. What antimony is to the stomach, calomel is to the intestines; and the resemblance is still closer, for calomel is capable of acting on the stomach and of exciting vomiting, and antimony frequently acts as a purgative; both, too, produce ptyalism. We, therefore, can supply by the one that property which the other is deficient in, and, in the combination of both, we have a means of evacuating the whole alimentary canal."

Barlow.

One grain of *calomel*, with a third of a grain of *tartrate of antimony*, or with a couple of grains of the antimonial, or of James's Powder, may be given once or twice a day, according to the severity of the symptoms, and the beneficial effects produced. The calomel ought to be carefully exhibited, taking care that the organs of circulation are not disturbed by its influence on the blood.

The antimonial, or the James's Powder, taken singly, have a powerful effect in tranquillising the heart, and five grains of either of them may be taken at bedtime, or a smaller dose may be repeated two or three times a day.

Of vomiting.

In some conditions of the stomach, great benefit is derived from antimony when it causes *vomiting;* and when the tongue is much discoloured and loaded, and at the same time there is a disposition to nausea, vomiting sometimes produces the best effects, not only evacuating morbid secretions or undigested food, but from the powerful influence which the act of vomiting has in restoring the balance of the thoracic circulation.

Whilst it is advisable not only to regulate the bowels, but also to evacuate any morbid secretions which they may contain, "it is at the same time proper that the medicines employed should be such as may keep the bowels regular without much purging." Cullen. However, it is surprising to find that in some instances where purgatives had been previously given to a great extent, the alimentary canal still remains loaded with excrementitious matters.

Sudorifics. The influence of *sweating* in relieving as well as preventing gout is remarkable, and that some unhealthy ingredient is by this excrementitious process discharged from the blood appears probable, a cretaceous-looking matter being contained in the cutaneous exhalation of gouty people.

Page 344. Cases have already been mentioned of gouty persons who never failed to ward off a paroxysm of gout by taking such exercise, and clothing themselves in such a manner as to produce a copious perspiration; and on this principle I would explain the great value which has been placed on exercise, and "the remarkable and almost incredible relief obtained by riding on horseback in most chronic diseases. For this kind of exercise strengthens all the digestive powers, whilst it revives the natural heat by the continual motion of the body, and enables the secretory vessels to perform their functions of purifying the blood in a proper manner:"—"Exercise, unless it be used daily, will do no service; for if it be interrupted at times, it will avail little in changing the constitution." Sydenham.

Sudorifics. Of equal value are *sudorific* medicines, and indeed those drugs which have the reputation of curing gout, such as colchicum, seldom produce their good effects without causing at the same time a more or less copious perspiration. To this effect upon the cutaneous system are also to be ascribed the benefit of the warm-bath, and of fomentations and poultices to the integument of the inflamed parts.

Diuretics.

Besides those remedial means which discharge by the alimentary canal, and the skin excrementitious matters from the blood, the kidneys are likewise an important outlet, more especially in the more advanced cases of gout, where a sero-albuminous fluid is infiltrated in the cellular tissue, or collected in the serous capsule of the heart.

Squills, digitalis, mercury, and the *alkalis* administered singly or combined with *opium*, are the most useful diuretics; and are to be exhibited according to the general rules that have been already pointed out.

Chap. XVIII.

The dropsy of the pericardium and anasarca.

When gouty inflammation has repeatedly affected the heart, there is often an accumulation of serum, both in the pericardium and also in the cellular tissue, which may by relieved by diuretics and absorbents. But when the effused fluid cannot be removed by internal medicines, it is then advisable to discharge it by an artificial opening in the skin. If it be collected to so great an extent as to create not only an alarming oppression in breathing, but to distend the skin of the lower limbs, a process of ulceration commences, and ultimately a slough of the integument separates, leaving an opening through which the fluid, infiltrated in the cellular tissue, oozes, and sometimes in such a quantity as to relieve all the symptoms, particularly the oppressed breathing. This process, employed by the economy to relieve the system of a morbid collection of sero-albuminous fluid, may be advantageously imitated by making punctures in the distended skin, through which the fluid may escape; a simple operation which has not usually been resorted to until a far advanced state of the disease, from the wounds when made with the common lancet not only being difficult to heal but often the surrounding skin sphacelating, and causing an incurable ulcer. Now all the evil effects of a wound made with a lancet are avoided, by making the puncture either with a round needle, or with the "glover's needle," which is triangular. Not only does the water flow more freely from such a puncture than from the small incision of a lancet, but it is less apt to close, and it is never followed by sphacelation and ulceration. From the advantages of this mode of puncturing the integument of an anasarcous limb, this palliative remedy should be unhesitatingly adopted whenever the integuments are so over-

Anasarca relieved by a natural process.

This process may be imitated.

By acupuncturation.

distended as to become a source of any considerable uneasiness, instead of postponing it from a notion that by delay any advantage can be obtained.

Expectorants.

From the intimate union of the lungs and heart not only are the functions of the lungs disturbed in gouty affections of the heart, but the pulmonary mucous-membrane is frequently more or less inflamed; and it is under such circumstances, when expectorants, such as *squills* and *ipecacuhana* may be advantageously administered.

See chap.

The remedies that improve the incretions.

Another class of medicines which are to be employed in the treatment of gout, are those which improve the *incretions*, whether these may have become unhealthy from unhealthy matters received by the incrementitious organs, or from the imperfect manner in which these organs have performed their functions.

"Whatever remedies assist nature" observes the great Sydenham, "to perform her functional duty, either by strengthening the stomach so that the aliments may be well digested, or the blood that it may sufficiently assimilate the chyle received into the mass, or the solids, so as to enable them the better to change the juices designed for their nutrition and growth into their proper substance; and whatever preserves the secretory vessels and the emunctories in such a state that the excrementitious parts of the whole system may be carried off in due time and order."

The haustus albus of the old pharmacopoeias.

Half a drachm of the *carbonate* and two drachms of the *sulphate* of magnesia, mixed in peppermint-water, is the most useful purgative combination with which I am acquainted, and it may be taken morning or at bed-time, and continued as long as the tone of the stomach improves by its use. The compound tinctures of *rhubarb*, and of *aloes*, and the decoction of aloes, are also well adapted to regulate the bowels, and improve the digestion of the gouty.

Gregory's Mixture.

The condition of the stomach is much relieved by the exhibition of *magnesia*, *potash*, and *ammonia*, combined with bitters and purgatives. Magnesia along with rhubarb and ginger, or some aromatic bitter, either in large doses occasionally or a prolonged course of small doses taken once or twice a day, materially improved the digestive function, and warded off a paroxysm of gout.

Cinchona extolled by Sydenham.

The *cinchona* has long been in repute for improving the tone of a gouty stomach. "Of all simples the Peruvian Bark is the best, for a few grains of it taken morning and evening strengthens and enlivens the blood."

Hoffman's tincture of cinchona.

The compound tincture of *cinchona* diluted with lime-water, is another useful formula, and the *mineral acids* are in many cases most grateful, and may be taken combined with cinchona.

Mineral waters, their effects.

There are also many of the *mineral waters* that have great repute in improving the digestive organs of gouty persons, and thus enabling them to have a paroxysm of articular gout. "I believe it," says the learned Cullen, "to be evident to everybody, that the phenomena of gout have a constant connection with the state of the stomach, and particularly that a certain strength of tone in this organ is necessary to produce a paroxysm of inflammatory gout."

Dietetics.

Whatever may be the influence of a hereditary predisposition to gout, it has been universally acknowledged that the severity of the disease greatly depends on *diet* and habits of life. The difference in its frequency amongst a peasantry who live chiefly on vegetable food, and the working class of a large community who consume a much larger proportion of animal food, is very remarkable. In the affluent classes of society the same observation is verified; for though there are individuals amongst them who severely suffer from gout, notwithstanding their habits of living are abstemious and temperate, yet the generality of persons who have been severely afflicted with this malady, are those who have indulged in the luxuries of the table.

"What is a consolation to me, and may be so to other gouty persons of small fortunes and slender means, is that kings, princes, generals, admirals, philosophers, and divines, and some other great men have thus lived and died. It may in a more special manner be affirmed of this disease, that it is destroys more rich than poor persons, and more wise men than fools; which seems to demonstrate the justice and strict impartiality of Providence, who abundantly supplies those that want some of the conveniences of life, with other advantages, and tempers its profusion to others with equal mixture of evils; so that it appears to be universally decreed that no man shall enjoy unmixed happiness or misery, but experience both; and this mixture of good and evil, so adapted to our weakness and perishable condition, is perhaps admirably suited to the present state."

Sydenham.

In the treatment of gout, the diet, therefore, is of the greatest importance, such being preferable which contains the smallest proportions of highly azotised food.

Chemical science affords a satisfactory explanation of the effect of diet in the formation of gout; for when carniverous animals are fed on vegetable food alone, no uric acid is found in the blood; a fact proved by Majendie, who fed carniverous animals on food containing little or no *azote*, and their urine became deprived both of uric acid and phosphate of lime.

Malt liquors recommended.

Malt liquors have been highly recommended as a beverage to gouty persons, and the "bitter" ale is often to them very palatable and refreshing.

"Gouty persons may drink a large draught of small beer, as, being generally subject to stone in the kidnies, the growth thereof is considerably obstructed by drinking at this time such a liquor, as it cools and cleanses the kidneys."

Sydenham.

Wine and spirits generally hurtful.

Wine and spirituous liquors are to be avoided in acute arthritic inflammation, whatever part of the body may be affected, but in the more chronic stages especially, after a severe attack of inflammatory gout, the system becomes so often debilitated, and the digestive functions so impaired, that besides bitters and carminatives, wine or brandy may be advantageously administered.

Case

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It is remarkable the effects of different kinds of wine in gouty persons. A gentleman, who has been long subject to gout, could produce an attack of articular gout in twenty-four hours by drinking only a single glass of champagne. Such an effect appears contradictory to the singular phenomena in the history of gout to which I have alluded, that an attack of articular gout may be brought on by *improving* the patient's health.

Exhibition of hæmatics.

Besides endeavouring to discharge from the blood its vitiated elements, and likewise to improve the incretions, material benefit is derived from changing the constituents of the blood.

See chap. XIX.

Thus when there are no febrile symptoms, *hæmatics* may be administered; and of these the preparations of *iron* have been long in repute, and, combined with *cinchona*, their *tonic* effects are often increased.

"The most effectual method for strengthening the stomach in gout is iron, which may be employed under various preparations; but, to me, the best appears to be the rust in fine powder, which may be given in large doses." Cullen.

The *sarsaparilla* infused in *lime-water*, and also the *taraxacum* are both useful in improving the incrementitious processes.

How far a medicinal substance such as *colchicum* may possess, besides its neurotic effects, some element which forms with the blood a new compound, and by which the excrementitious processes of the digestive canal, of the kidneys, and of the skin, are altered, is a problem yet beyond our knowledge of the nature of the processes which are performed in the vital laboratory. But even a successful analysis of gouty arterial blood might lead us into error, were we to expect that by adding new elements we should be able to produce new combinations in the blood by which its hurtful properties would be destroyed.

The pathologist must therefore receive chemical analyses with great caution; for whatever combinations or decompositions may be made in the chemical, we must not conclude that similar processes would take place with the same ingredients in the vital laboratory where there are so many disturbing actions—actions under the influence and control of other laws.

Blood-letting to be employed.

Besides the means which are applicable to the cure of the specific disease, those remedies are to be employed which will allay the accompanying febrile symptoms.

When the constitutional excitement is great, and the local inflammation severe, blood should be abstracted from the arm, and an antiphlogistic treatment rigidly followed, keeping in mind that symptoms will remain,—symptoms characteristic of the specific disease, but which cannot be relieved by depletion.

Whenever there is tenderness to the touch, or uneasy feelings in the precordial region, oppressed breathing, accompanied with a small wiry pulse, and a strong impulse of the heart, then blood abstracted by a few *leeches*, either from the chest or feet, often produces a decided alleviation of the symptoms; and the leeches ought to be repeated according to the effects produced, and the severity of the remaining symptoms.

As gout is frequently combined with *plethora*, in the treatment

When gout is combined with plethora.

of such cases not only the means of remedying the vitiated qualities of the blood is to be considered, but also the propriety of diminishing its quantity. Indeed, the depletive system which is so beneficially emyloyed in all other specific diseases when these are accompanied by plethora, is applicable to the treatment of gout, and especially to the arthritic affections of the heart. The use of bloodletting in gout, must, as in all other specific diseases however, be cautiously employed, for whilst on the one hand the symptoms of plethora are alleviated by the depletion, if carried further it is followed by great debility, the local inflammation assuming a chronic form, difficult to subdue.

The use of blood-letting in gout.

Gout relieved by spontaneous hæmorrhage.

The connection of the *hæmorrhoidal flux* with gout attracted the notice of the early writers in medicine, and the relief obtained by the spontaneous evacuation of blood in arthritic affections, pointed out the propriety of artificial bloodletting, especially the application of leeches to the hæmorrhoidal vessels, in the treatment of certain cases of gout. The repeated and large quantities of blood lost, by spontaneous hæmorrhages, and the relief obtained in cases where there were symptoms indicating a debilitated state of the system, and symptoms of a nervous character, shows how even under such circumstances a local depletion ought to be adopted.

In women of a gouty diathesis, suffering from inflammatory symptoms of the heart, and these connected with a disordered state of the uterine system, decided benefit is derived from applying a few leeches, either on the hæmorrhoidal vessels or upon the feet. And, I may here remark, that as a congested state of the portal system is indicated by a disposition to hæmorrhoids, the beneficial effects which follows a discharge of blood from the hæmorrhoidal vessels is readily explained.

"From the last considerations, it seems probable, that, during the time of paroxysms, some measures may be taken to moderate the violence of the inflammation and pain; and, particularly, that in first paroxysms, and in the young and vigorous, bloodletting at the arm may be practised with advantage; but I am persuaded, that this practice cannot be repeated often with safety. I believe, however, that bleeding by *leeches on the foot*, and upon the inflamed part, may be practised and repeated with greater safety;

and I have known instances of its having been practised with safety to moderate and shorten paroxysms, but how far it may be carried we have not had experience enough to determine."

Cullen.

The exhibition of Neurotics.

During a local inflammatory attack of gout, the *pain* varies exceedingly, according to the part affected, and is much less severe when in the tissues of the heart than in the synovial capsules. The neurotics usually given to relieve the pain of gout, are opium, hyosciamus, beladonna, colchicum, and the hydrocyanic acid. Of these there is no one to be more depended upon to allay pain than *opium;* whilst *digitalis, belladonna, hyosciamus,* and the *hydrocyanic acid* are useful in allaying an irritable action of the heart.

Chap. XIX.

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Use of opium.

"*Opiates* give the most certain relief from pain; but, when given in the beginning of gouty paroxysms, they occasion these to return with greater violence. When, however, the paroxysms shall have abated in their violence, but still continue to return, so as to occasion painful and restless nights, opiates may be then given with safety and advantage, especially to persons advanced in life, and who have been often affected with the disease."

Cullen.

An irritable state of the heart that often remains after all inflammatory symptoms have subsided, may be relieved by *camphor, ammonia,* and *galbanum,* and the ammoniated tincture of *valerian;* and small doses of *colchicum,* are also essentially useful in similar cases.

Neurotics may be applied to the cutaneous surface as well as taken internally; and in the more mild affections of the heart, and in those where depletive measures have been employed, an embrocation or plaster of *belladonna* may be applied on the chest or on the back, betwixt the scapulæ.

And of colchicum.

After the acute inflammatory symptoms have yielded, the *colchicum* has most beneficial effects, diminishing the increased action of the heart, producing copious perspiration, urinary secretion, and alvine evacuations. From five to twenty drops of the colchicum wine may be taken once or twice a day, according to the severity of the symptoms. It ought always to be given along with the *citrate of ammonia,* or *potash,* or with the *sulphate,* and *carbonate* of *magnesia,* by which combinations the action upon the skin, kidneys, and alimentary canal are rendered more certain, for it is when such action does not take place on the excretive organs that the poisonous effects of colchicum are produced. In this respect colchicum resembles *mercury*, for if mercury purges, sweats, or increases the flow of urine, it is discharged from the blood; whereas if none of these effects takes place, it is retained in the blood, and becomes a poison to the whole economy.

In administering colchicum, two distinct effects are produced by it; it allays pain, by its action on the sensory nerves, and it forms new compounds with the blood, by which the excrementitious processes of the alimentary canal, the kidneys, and the skin are altered, and the noxious elements separated from the vital fluid. Each of these effects must be produced by different elements, of which the colchicum is composed; for, like opium and tobacco, colchicum contains principles, which possess perfectly different qualities.

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One of these elements of colchicum acts upon the nervous system, and the other, which, like some other of the same class of medicinal bodies, contains an element *sui generis*, is poisonous, and if not discharged from the system by the excrementitious processes, it vitiates the blood, and has a pernicious effect on certain organs.

The specific remedies for gout.

These remarks on colchicum apply to some other medicines which have been considered to have a *specific* effect in curing gout. *Hellebore*, so much esteemed by the ancients, and the celebrated "Portland Powder," the "Eau Medicinale" and "Wilson's Gout Tincture," whilst they alleviate the pain of gout, and subdue the inflammatory symptoms, are all frequently followed by the same pernicious effects on the system as colchicum. That such injurious effects of these medicines are produced by their influence on some particular organ we may conclude from the numerous cases which are recorded where they are said to have brought on apoplexy, asthma, and dropsy.

Speaking of the baneful effects of the "Portland Powder," and similar effects I have often seen caused by colchicum, Cullen observes:

"One of these (remedies) is what has been named in England the '*Portland Powder*.' This is not a new medicine, but is mentioned by Galen, and, with some little variation in its composition, has been mentioned by the writers of almost every age since that time. It appears to have been at times in fashion, and to again have fallen into neglect; and I think that this last has been owing to its having been found to be in many instances pernicious.

"In every instance which I have known of its exhibition for the length of time prescribed, the persons who have taken it were indeed afterwards free from any inflammatory affection of the joints, but they were affected with many symptoms of the atonic gout; and all, soon after finishing their course of the medicine, have been attacked with apoplexy, asthma, or dropsy, which proved fatal.

"I have had occasion to know, or to be exactly informed, of the fate of nine or ten persons who had taken this medicine (the Portland Powder) for the time prescribed, which is two years. These persons had been liable for some years before to have a fit of a regular or very painful inflammatory gout, once at least, and frequently twice in the course of a year; but after they had taken the medicine for some time, they were quite free from any fit of inflammatory gout; and particularly when they had completed the course prescribed had never a regular fit, or any inflammation of the extremities for the rest of their life.

"In no instance, however, that I have known, was the health of these persons tolerably entire. Some, after finishing the course of their medicine, became valetudinary in different shapes, and particularly more affected with *dyspeptic*, and what are called *nervous* complaints, and lowness of spirits. In every one of them, before a year had passed after finishing the course of the powders, some hydropic symptoms appeared, which gradually increased in the form of ascites or hydrothorax, especially the latter joined with anarsaca, in less than two or at most three years all proved fatal."

Cullen's Mat. Med. vol. ii.

Similar effects of other medicinal bodies.

The same phenomena are illustrated in the effects of some medicines in other diseases, especially in the effects of *mercury*. This remedy, as I have before observed, if absorbed into the blood, not only contaminates the sanguiferous system, but often causes diseases in particular organs; and if a sufficient quantity of *iodine* be absorbed to contaminate the blood, there is a like specific effect produced on some organ.

Derivatives.

In no disease is the use of *derivatives* of more importance than in the treatment of gout, for in those cases where an important organ, as the heart, is affected with gouty inflammation we may be able, by that class of remedies, to translate the gout from the heart to a less important organ.

This principle, for the treatment of gout in the heart, is applicable to those cases where the inflammatory attack has commenced in the heart, as well as to those where the arthritic inflammation has left the extremities and been translated to the heart.

When the circulation is disturbed from the presence of arthritic inflammation in the heart, besides the local treatment, *leeches*, applied to the *feet*, have a powerful influence in subduing the inordinate action of the heart, not only by the blood which they remove, but by the local irritation which they frequently create on the skin, and by which the gout may be translated from the chest to the feet.

To effect a similar purpose the *pedeluvium*, with mustard or vinegar, *friction*, *blisters* on the calf of the legs, *sinapisms* to the feet, or *dry cupping* to the soles of the feet, as recommended by Hoffman, may be employed; and even though the gout should not be translated to the extremities, these means will assist in subduing the local affection of the heart.

Case.

A gentleman, in the sixty-fifth year of his age, complained of a pain in the region of the *heart*, dyspnœa, anxiety of countenance, loaded and slate-coloured tongue, a pulse quick, very small; fluttering, easily compressed and irregular. He has frequently had attacks of *gout*, had been ailing for some days. Six leeches were applied to one foot, and a grain of calomel with five of James's Powder given every four hours. Next day he was much relieved of the pain in the heart's region. Leeches were repeated on the other foot. On the following day the pain was nearly gone. The James's Powder and saline medicines were continued, and also the pedeluvium with mustard and vinegar. On the third day the pulse was quite subdued, but frequent and intermitting; the tongue had the same slate-coloured fur. Five grains of calomel were now given; after which he had a good night, and a belladonna plaister was applied to the chest. On the following day the peculiar fur on the tongue had disappeared, the calomel acted once on the bowels, the pulse was diminished in frequency, and regular, and he returned home on the sixth day convalescent. After repeated attacks, the particulars of which did not come within my notice, he died three years afterwards; and I received the following account of the morbid appearances:

"The pericardium contained much water, the right auricle and ventricle very much enlarged and filled with blood. The left ventricle was so relaxed that it was flattened, and the apex of the right ventricle extended beyond it. The mitral valves were in some parts greatly thickened, and so were the tricrispid. The walls of the left ventricle were flaccid and pale."

Cases.

An Officer whose general health was considerably impaired from long services in India, and who had often suffered from articular gout, applied to me on account of a difficulty in breathing, tenderness in the region of the heart, and palpitations, with a frequent and irregular pulse, all which symptoms he had suffered for some days. Three leeches were applied to the foot, a dose of James's Powders, combined with calomel, was given at bedtime, and on the following day he wrote,—"The leeches took away a great deal of blood, and as you predicted, the gout is now in my foot, which is much swelled."

A Lady, advanced in years, who had repeatedly suffered from gout in the feet, was attacked with an embarrassment in breathing, and a great impulse and disturbance in the action of the heart, which symptoms I attributed to an attack of arthritic inflammation. The application of four leeches to one of her feet caused, on the following day, a good deal of cutaneous irritation, and in three days it was, much to her surprise, succeeded by a regular fit of gout in the great toe; after which the difficulty in respiration, and the disturbance of the heart, were completely relieved.

CHAPTER XXVII.

OF THE RHEUMATIC INFLAMMATION OF THE HEART.

General observations on rheumatism of the heart; the original observations of Wells, Pitcairn, and Baillie on this disease; the tissues of the heart affected by it; the changes which take place in them; in what respects these changes resemble and differ from those produced by arthritic inflammation; the changes of the blood in rheumatism; differences in the constituents of rheumatic and gouty blood; the large proportion of fibrine in rheumatic blood; this accounted for; the causes of rheumatic inflammation of the heart; the heart and joints simultaneously affected; those who are most frequently affected with rheumatism; rheumatism combined with plethora and gout; the physiological symptoms of rheumatic inflammation of the heart; condition of the digestive organs; changes in the urine; changes in the pulmonary, and in the cerebro-spinal systems; the anatomical symptoms; changes in the impulse and sounds of the heart, and in the cardiac and arterial pulse; changes in the sensibility and resonance of the chest; symptoms of acute inflammation of the pericardium and endocardium; these membranes may be inflamed separately or simultaneously; diagnostic characters of rheumatic inflammation of the heart; exanthematous inflammations of the heart; treatment of rheumatism of the heart.

UNTIL the observations of Wells, Pitcairn, and Baillie,* a rheumatic affection of the heart had not been described by any pathologist; though some subsequent writers on this subject have been so uncourteous as, by not noticing their observations, to endeavour to deny them the merit of originality. I may, however, remark, that in the voluminous and prolix writings which have since appeared, little additional matter will be found either interesting to the pathologist or useful to the practitioner. The phenomena of rheumatic and idiopathic inflammation have been confounded with one another, whilst gouty inflammation entirely escaped their observation. Had, indeed, their attention been more directed to the physiological symptoms and history of these inflammatory affections than to the mere physical signs, the differences in the character of the arthritic and rheumatic inflammation of the heart could not have failed to have arrested their notice.

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* "On Rheumatism of the Heart, by William Charles Wells, M.D.," in the "Transactions of a Society for the Improvement of Medical and Chirurgical Knowledge." Vol. iii. London, 1812.

In the whole category of diseases none differ more from one another than the three species which nosologists have arranged under the genus of rheumatism,—the *articular*, the *muscular*, and the *neuralgic*. The phenomena of each of these species, the tissues which are affected by them, the causes that produce them, the condition of the sanguiferous system accompanying them, and the treatment which each species requires, are all perfectly dissimilar.

In the heart, rheumatic inflammation is always seated in its *sero-serous* membranes; in like manner as in articular rheumatism, the inflammation affects the capsule of the joints.

That rheumatism does not affect the *muscular* structure of the heart, we may venture to infer from the circumstance, that such an attack would prove instantly fatal; for it is well known, that when a muscle is affected with rheumatism, such as we so often experience in the muscles of the neck and loins, the muscular action suddenly becomes so acutely painful as to render the contractions quite insupportable. It therefore seems to me, that acute rheumatism never affects the muscles of the heart; nor any of those, it is highly probable, of organic life. Neither have we evidence that the cardiac *nerves* are ever affected with rheumatism, for, did that happen, life would certainly be immediately extinguished. The nervous and the muscular systems of the heart, unlike those of other portions of these systems, would, therefore, seem to be exempt from a disease so very frequent in the organs of organic life, and an attack of which would instantly prove fatal.

Whilst arthritic inflammation usually attacks the endocardium, the pericardium is most frequently the seat of rheumatism, though both these membranes are, in many instances, simultaneously inflamed.

Morbid changes.

The morbid changes, which are the effects of rheumatic inflammation either of the pericardium or endocardium, are, in most

Lymph effused.

respects, like those of arthritic inflammation. There is effused on both those serous surfaces coagulable lymph, and a sero-albuminous fluid is collected in the cavity of the pericardium. The lymph varies in quantity and in consistence, forming on the pericardium an adventitious membrane, which produces adhesions between opposite parts of its surface; and on the encocardium those various changes in the thickness and form, observed especially of the interior surface of the heart, and of the valvular apparatus.

Although these morbid changes appear similar to those of arthritic inflammation, yet, in one respect, they differ essentially; none of the cretaceous matter,—the urate of soda, which I have shown to be pathognomonic of gout, being ever deposited in the tissues which have been affected with simple rheumatic inflammation.

Changes in the blood.

The *eye* affords a favourable opportunity of observing the characters and morbid changes of rheumatic, as it does of arthritic ophthalmia, and were the opportunity afforded in other organs, the same morbid phenomena would no doubt be recognized.

The condition of the sanguiferous system in rheumatism points out the important share which the *blood* has in the production of some of the phenomena accompanying that disease. At the same time it must be admitted, that chemical analysis has only made known to us the changes of the rheumatic venous blood taken from the arm.

Characters of rheumatic blood.

The rheumatic venous blood is essentially different from the gouty blood; for although we have in gout and plethora combined an excess of fibrine, yet the urate of soda, an element in gouty blood, has not been found in rheumatic blood.

The blood in acute rheumatism possesses the same morbid characters as the blood in all inflammatory affections, the quantity of *fibrine* being generally greater in the rheumatic than in the blood of other febrile diseases.

This remarkable difference in the gouty and rheumatic blood accords with the difference in the causes which produce these diseases; for whilst the blood of gouty persons is vitiated by a long-continued derangement both of the excrementitious and incrementitious processes, and contains new elements, the rheumatic blood is changed suddenly from some atmospheric influence, and has only the *proportions* of the natural constituents of the blood changed.

The question has been agitated—from whence is derived this additional quantity of fibrine in rheumatic blood? and whether should it be considered as a morbid product, or an increase of that same element which constitutes health and strength? As the *fibrine* has been considered to be that constituent of the blood which constitutes health, it appears contradictory that an increase of its proportions should become one of those remarkable changes of the blood in inflammatory diseases.

There are two phenomena connected with inflammatory diseases, and which are especially remarkable in rheumatism. Not only is there an increase in the proportion of *fibrine* in the blood, but the inflamed part separates fibrine from the blood, forming a morbid product; and the circumstance of its increase during the process of inflammation shows that it must be eliminated in some other manner, or from some other materials than those from which it is furnished when a person is in health. The emaciation, or loss of flesh, which takes place to so great a degree in persons attacked with any of the *phlegmasiæ*, may explain the great increase in the proportion of fibrine which the blood contains in these diseases. The muscle, the chief element in whose composition is fibrine, and which is so rapidly absorbed during inflammation, must go somewhere—and why not to the blood?

In all febrile, as well as inflammatory diseases, we observe that processes are performed by the different organs of excretion,—by the alimentary canal, by the kidneys, and by the pulmonary and cutaneous surfaces; and when these excrementitious functions are not duly performed, then any vitiated elements in the blood are deposited in different cavities, or in the parenchyma of different organs. The mucous membranes secrete a *muco-puriform* fluid—the cellular membrane *pus*, and the serous and synovial membranes *fibrine*.

Rheumatic inflammation of the heart can usually be traced to an exposure to cold and moisture; such as sitting in wet clothes, Causes of rheumatism.

sleeping in a cold and damp bed, getting wet feet, taking a cold drink when overheated.

Cases recorded by Wells.

In one case the attack came on three days after being heated in a theatre, and whilst in that state drinking a considerable quantity of *porter*.

In another case the attack came on from falling into a pond of water, when suffering from articular rheumatism.

In a third case a woman, while suffering from an attack of articular rheumatism caused by standing some time in a cold cellar, wetted her feet; two days after which the pains in the joints abated, and she was attacked with palpitation.

In several instances I have known it caused by sleeping in a damp bed.

Heart and joints affected simultaneously;

When rheumatism affects the heart it is sooner or later followed by pain in some of the joints of the extremities, or the serous membranes of the heart and the synovial membranes of the joints are simultaneously inflamed. That in all cases of articular rheumatism the heart is affected, we may conclude from the derangement in its functions at the very commencement of the febrile symptoms.

or it may be translated.

In some instances, rheumatism, like gout, is *translated* to the heart from the extremities, or from the heart to the extremities; all these phenomena, observable in rheumatism of the heart, being analogous to those of gout.

In whom most frequent.

Whilst gout rarely affects young people, rheumatism, on the contrary, is most frequently met with in persons of all ages and of both sexes.

The comparative frequency of rheumatic and arthritic affections of the heart in different classes of society is a striking feature in the history of these diseases; for whilst *gout* is usually met with amongst those who consume a large proportion of animal food, and lead a life of sensual gratification, rheumatism is most frequent in those who live chiefly on milk and vegetables, and who are exposed to much bodily fatigue and atmospheric changes.

This comparative difference in the frequency of rheumatic and gouty affections in the two classes of society, affords a striking proof of the danger of drawing general conclusions, or attempting to give rules for the treatment of diseases from observations made alone on particular classes; for it can be readily conceived that the same ailment in a soldier or sailor, and in a person of delicate constitution and luxurious habits, must have in many respects a very different character.

The same remark forcibly applies to rheumatic inflammation of the heart, the cases of rheumatic *pericarditis* referred to by different writers have almost all of them been selected from public hospitals; whilst this disease, especially in its more severe forms, is comparatively of rare occurrence in the opulent classes of the community.

Rheumatism combined

The complications of rheumatism with other diseases are important to consider; for though the heart may be severely attacked with rheumatism, yet such inflammation soon participates in any constitutional peculiarity or derangement of the general health which may have previously existed.

with plethora.

If the patient be plethoric, the attack assumes a form which is accompanied with general *plethora*.

If the person be of a gouty diathesis, the rheumatic attack is modified by that diathesis; and such combinations led nosologists to divide rheumatism into certain species.

The physiological symptom of rheumatic inflammation.

As in gout, it is the *physiological* symptoms by which alone we are enabled to distinguish rheumatic affections of the heart; and it appears incredible that so many inquirers into the diseases of the heart should have remained quite satisfied with a detailed account of its morbid changes, and not have investigated the condition of the general system by which the changes were produced, as such an inquiry would not only have pointed out their true nature, but would have afforded a legitimate channel to discover some appropriate remedies.

Thus far we have been contemplating the rheumatic inflammation of the heart in its acute form; but rheumatism, like gout, is met with in every possible degree of intensity, and duration: and in those who have suffered from rheumatism of the heart, a chronic state may continue long after the febrile condition has abated. Like in other inflammatory diseases, we may therefore anticipate that in rheumatism there will necessarily take place all the different degrees of vascular turgescence, from that state of the capillary system, where the increased redness appears to be chiefly caused by arterial blood, to those cases where the turgid vessels appear chiefly distended by venous blood.

In narrating the symptoms of rheumatic inflammation, I am necessarily compelled to mention some which may appertain to *pericarditis*, and others to *endocarditis;* but, as in the majority of cases, both the serous tissues are affected, it would be difficult to separate the two classes of symptoms.

Condition of the digestive organs.

Whatever derangement may be detected in the *digestive* organs, it is probable, from the nature of the causes of rheumatism, that these must have existed previously to the rheumatic attack; whereas in gout a derangement of the alimentary canal has always preceded the arthritic inflammation.

Appearance of the tongue.

In rheumatism the *tongue* is increased in bulk, has a milk white colour, and the central portion generally covered with a brown fur.

The changes in the urine,

In acute rheumatic inflammation the *urine* is scanty, and its qualities are considerably changed. Its colour becomes of a deep red, and it deposits a copious sediment of urea.

in the skin,

The *cutaneous* surface is remarkable for the abundant moisture with which it is almost constantly covered, and its peculiar acrid and offensive odour from the lactic acid which it contains.

and in the lungs.

The condition of the *pulmonary* apparatus is greatly influenced in this, as it must necessarily be in all the inflammatory affections of the heart, and the changes in the respiration caused by changes in the pulmonary circulation, differ strikingly from those caused by diseased lungs. The breathing becomes more rapid, and the inspirations and expirations are proportionably diminished, when a portion of lung is unfit to oxygenate the blood; but in those affections, such as the inflammatory diseases of the heart, the pulmonary circulation deranges the regularity of the inspirations and expirations, and those instinctive acts, such as sobbing and sighing, are resorted to by the *vis medicatrix* to restore and preserve the balance of the circulation.

The pulmonary *exhalation*, like that of the skin, is often much tainted, and has somewhat a similar acid smell.

There is always a great disturbance of the *cerebro-spinal* system. The derangement in the circulation of this system is marked by want of sleep, a distressing restlessness, and changing of posture; and there is an appalling expression in the countenance characteristic of the greatest anxiety, and even terror, which leaves an impression upon an observer that he never can forget. This *facies propria*, so remarkable in some diseases of the heart, is quite unlike the expression of those suffering from diseased lungs.

The anatomical symptoms.

As rheumatic inflammation of the heart varies in every possible degree, so do we find that the symptoms are equally variable in their intensity.

Changes in the impulse.

In acute articular rheumatism, the action of the heart is much changed. Its *frequency* and *impulse* are increased, and the beatings are generally sufficiently strong to be perceived, by placing the hand upon the chest, and even to be felt by the patient.

A peculiar *vibratory* feeling in the arterial pulse, which has been long noted as characteristic of rheumatism, indicates a condition of the central organ, different from the change in its action which accompanies inflammatory diseases of other organs.

Signs derived by percussion.

By *percussion* the precordial region is found more or less dull, and the chest has sometimes been remarked as more prominent; and there is also an absence of the respiratory murmur over this space, from the displacement of the lungs.

Luis.

The local pain.

If the inflammation be seated in the *pericardium*, there is a tenderness, and more or less pain, referred chiefly to the region of the heart, which is increased by pressure, by a full inspiration, or by coughing, symptoms resembling those of an inflamed portion of pleura.

Changes in the sounds.

An inflamed state of the pericardium can have no more influence in changing the currents of the blood than any other cause which alters the functions of the heart; but no portion of the *endocardium* can be inflamed, without producing some change in the currents of the blood, and it may be anticipated that there will be changes in the currents and in the *sounds*, according as the inflammation is seated, in that portion of the endocardium which covers the right or left heart, or the auricle or ventricle of either heart.

The intensity of the *sounds* of the heart is increased during the first period of the inflammation of the pericardium, but they become dull, according to the quantity and to the density of the effusion into its cavity. As in many other of the heart's diseases, the "bellows-sound" has also been remarked in pericarditis; but this sound cannot be considered as an equivocal sign, either of pericarditis or endocarditis, for it is present in so many other diseases of the heart, both functional and organic.

Pericardial friction.

A sound of '*friction*,' such as that of a file, or of dry leather, has been described, and supposed to be caused by the mechanical rubbing of the opposite surfaces of the diseased pericardium; an opinion which has been retailed from one author to another, as a satisfactory explanation of this peculiar sound.

Explained erroneously.

Admitting the possibility that sounds of friction exist when the surfaces of the pericardium are covered with a lamina of coagulating lymph, and its cavity more or less filled with a sero-albuminous fluid, is it legitimate to suppose that any friction of the surfaces of this capsule, caused by the motion of the heart, could produce an audible sound? The fallacy of such a hypothesis is proved, by the effect that is known to be produced by rubbing two rough files, or of clipping a piece of glass while under water; the vibration being, in these experiments, so greatly checked, that the sounds are nearly destroyed, or at least rendered imperceptible. How therefore can credence be given to the opinion, that a sound could emanate from a cavity, such as the pericardium, filled with a substance of the consistence of coagulable lymph, when the parietes were moved by the motions of the heart? And when adhesions have taken place betwixt the opposite sides of the pericardium, still more untenable must be the hypothesis, that any sound could emanate from the movements of the heart by causing friction of the opposite sides of the pericardium. The affectation of displaying a nicety in distinguishing sounds in the heart has doubtless led to most unphilosophical modes of explaining some of them, and mischievous effects have arisen from erroneously attributing them to particular morbid changes in the heart's structure.

Symptoms of the Endocardium inflamed.

When the inflammation is seated in the *endocardium*, there is little or no local pain, but a feeling of oppression in the region of the heart. The beatings of the heart are perceptible to the hand, applied on the precordial region, and are sometimes so strong that they elevate the ribs.

But the principal symptoms of the inflamed state of the *endocardium* arise from the changes which must necessarily take place in the currents of the blood passing over the inflamed surfaces of the heart's cavities; the intensity, the rhythm, and the characters of the sounds being thus varied, according to the place, the extent, and the degree of the inflammation.

The inflamed state of the endocardium, and the masses of coagulated lymph adhering to its surface, must cause a great disturbance in the action of the heart, necessarily changing the characters of the cardiac and arterial pulse, and, likewise, of the *sounds* of the heart. The beatings of the heart are irregular, unequal, and intermittent. The arterial pulse is small, frequent, contracted, unequal, irregular, or intermittent. Whilst the arterial pulse is small the heart beats violently; and it has sometimes been remarked, that the number of the arterial and cardiac pulsations did not correspond.

Bulliot.

Pericarditis and endocarditis combined.

Pericarditis, endocarditis, and pleuritis combined.

As has been observed that in most cases of rheumatic carditis both the serous membranes of the heart are affected, the symptoms may become variously combined; and as the inflammation is seldom confined not only to one of the serous membranes, but frequently extends to the serous membrane of the lungs, the symptoms become still more complicated; their assemblage depending on the extent as well as on the degree of the inflammation of the inflamed surfaces.

Pericarditis and *pleurisy* may indeed be mistaken for one another, and care is necessary to distinguish them. One striking difference is the countenance in pleurisy—the patient wanting that expression of terror and despair, so characteristic of pericarditis. In pleurisy, the local pains are more severe, there is great difficulty and pain in expanding the thorax; and the inspirations are always shortened, and not irregular, as those in pericarditis.

Diagnosis of rheumatic inflammation.

The circumstance that some of the phenomena of *rheumatism* resemble those of *gout* has led these diseases to be often mistaken for one another; but the striking difference in the causes that produce them, the different systems of the economy effected, the morbid changes they produce in certain tissues, and also in the blood, and especially the treatment best adapted for each, sufficiently point out the differences of the arthritic and rheumatic inflammations of the heart. Such discordant opinions have, I apprehend, arisen from the peculiar assemblage of symptoms which frequently appear when rheumatism affects a person of a gouty diathesis, and likewise on certain elementary tissues being liable to both diseases; and the treatment most appropriate for the one disease being as different from that required for the other as the causes that produce them. In gout the chief curative indications is directed to improve the incretions and regulate the excretions; but in rheumatism we endeavour to restore the disturbed functions of the cutaneous capillaries; whilst the history of the case, the rapidity in the action of the heart, the vibratory pulse, and fixed or erratic pains in the limbs and joints, all point out the rheumatic character of the inflammation.

Glancing over the numerous writings on endocarditis and pericarditis, it must appear evident that these descriptions both apply to arthritic and rheumatic carditis; and, as I have already said, except inflammation caused by wounds or external violence, all the inflammatory diseases to which the heart is subject, are of a *specific* character.

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In this category, I include, besides gout and rheumatism, those inflammatory affections of the serous membranes of the heart which come on after the febrile symptoms of *measles*, *small-pox*, and *scarlatina*, and that are caused from exposure to a sudden change in the temperature of the atmosphere, to an imprudence in regimen, or to a loaded state of the alimentary canal.

The same observation, I am inclined to believe, is applicable to all other serous membranes, as well as to those of the heart. Unless in such cases where the testis has been inflamed from an injury, or from sympathy with a disease in the urethra, we never see effusion into the inflamed vaginal tunic but in persons of an arthritic diathesis; and unless when a joint has been inflamed from an injury, how seldom do we observe it diseased but from scrofulous, rheumatic, arthritic, or syphilitic inflammation?

This opinion is corroborated by observing those inflammations of the eye where the capsule of the aqueous humour is inflamed;

unless from an injury, that serous membrane is never inflamed but in those who have some specific disease.

The pleura and the peritoneum may be deemed exceptions to the preceding observation, these being examples of serous membranes frequently affected with common or idiopathic inflammation—a circumstance which, however, admits of a satisfactory explanation from these membranes being much exposed to vicissitudes of temperature; the cold air which is transmitted into the lungs being brought into almost immediate contact with the pulmonary pleura; and in like manner the peritoneum is not effectually protected from the influence of cold from without, nor from internal agents, as most of the other serous capsules.

From what has been said, an important practical doctrine is established,—that we ought to suspect the existence of some specific disease, whenever any of the serous capsules are affected with inflammation,—and more particularly if that inflammation assume a sub-acute or chronic character.

Treatment.—The treatment which should be adopted, in the acute form of endocarditis and pericarditis, is precisely that which is usually employed in severe rheumatic inflammation of other organs; and these rules have been distinctly pointed out, by those to whom we are indebted for the first account of this disease.

When rheumatism is caused by some change in the functions of the cutaneous capillaries, from a sudden alteration of temperature, the first curative indication should be, to restore the function of the skin; and there is no remedy so powerful in effecting this purpose as an *emetic*, and in the exhibition of the *tartrate of antimony*.

"In several cases of chronic *rheumatism* I have, by the full effect of an *emetic* (antimonial) succeeded in dislodging from the stomach a load of viscid and opaque *mucus*, followed by dark, slimy, and fœtid stools." Barlow.

Bloodletting.

The local pain and difficulty in respiration will also require for their relief the abstraction of blood; and this is most effectually accomplished by *phlebotomy*. The quantity to be removed must be entirely regulated by the effect produced on the cardiac and arterial pulse whilst the blood is flowing from the vein; and even should the action of the heart become subdued, it ought afterwards to be carefully watched, and more blood abstracted, by renewing the application of the bandage on the arm whenever the pulse acquires volume, and the local symptoms return.

It is after the febrile symptoms have been relieved by general bloodletting, and other depletive means, that local bloodletting, such as the application of *leeches* on the præcordial region, or upon the feet, may be advantageously employed. A few doses of *opium* combined with *calomel*, and opium taken singly, or *Dover's Powder*, are also applicable during the more acute symptoms.

When the acute symptoms have been subdued, and when the disease of the heart assumes a more chronic form, then besides rheumatism there is generally some other disturbance in the system, more especially its combination with gout, by which the rheumatism is modified, and which requires some additional treatment. In such cases those remedies become necessary which improve the *incretions*, as well as those that regulate the *excretions*, and these are to be accomplished by employing those means which have already been explained. See Chap. xix.

The excessive perspiration which accompany acute rheumatism may be often relieved by *Dover's Powder*. On the same principles as an emetic changes vomiting, and a purgative diarrhœa, so will a diaphoretic check profuse perspiration.

The powerful influence of *mercury* in promoting absorption renders its use particularly applicable to those cases where there is much effusion in the pericardium, and the *chinchona* has long been in repute for the treatment of chronic rheumatism, or after the more acute inflammatory symptoms have been subdued. The powder given in small doses, combined with the *carbonate of soda*, frequently repeated, is a most useful remedy. As healthy venous blood contains carbonate of soda, is it not probable that the medicinal effects of soda are produced through the medium of the *blood?*

The *hydryodate of potass* and *colchicum* may also be advantageously employed; and *counter-irritants* are no less useful in rheumatic than in arthritic carditis.

The most decided benefit I have often observed from it is a couple of grains of hydryodate of potass taken two or three times a day, especially in those who have suffered from rheumatism, and in whom, after the local symptoms have abated, the action of the heart continues disturbed.

Before concluding these observations on the treatment of rheumatism of the heart, I may observe that rheumatic *ophthalmia* affords an excellent opportunity of watching the influence of the curative means employed; for although a just estimate may be formed of their effects, when the disease is in the heart, by the changes in the symptoms, yet in the ophthalmia the various changes can be seen going on in the vascular system of the eye; and thus the precise effect of the means that are adopted can be ascertained.

CHAPTER XXVIII.

DISEASES OF THE DIFFERENT TISSUES OF THE HEART.

Diseases of the different tissues of the heart; diseases of the coronary vessels; the limited knowledge of these diseases; their importance; peculiarities in the arrangement of these vessels; Abernethy's observations on the foramina of Thebesius; pathological inferences; coronary congestion; dilatation of the coronary arteries; inflammation of their coats; ossification; aneurism; diseases of the coronary veins; general observations on the symptoms, diagnosis, and treatment of the diseases of the coronary vessels.

We now proceed to consider the diseased changes which take place in each of the particular tissues of the heart; and consistent with the original design of this work, it is not my intention to collate the numerous materials which are to be found in medical writings on this subject; but only to give a general account of these changes. The museums which abound not only in this metropolis, but also in so many parts of the British dominions, all of which vie with each other in their intrinsic value, and in the liberal manner they are thrown open to the student, have materially contributed to promote the knowledge of morbid anatomy; and along with the excellent catalogues of the morbid preparations which have been published, these collections may be most advantageously consulted by all those who have an opportunity of examining them during their pathological investigations.

Amongst the numerous and zealous inquirers into the pathology of the heart, it is remarkable that the diseases of the coronary vessels should not have been carefully investigated; for, except a few morbid changes in their coats, little notice has been taken in systemic works of the maladies of this important portion of the heart's structure. That arteries perform essential functions, we see exemplified when those of a limb become ossified; the heart then not being alone sufficient to carry on the circulation,—so that, sooner or later, the limb mortifies; from which we may infer that great changes must take place in the heart's functions from changes in the condition of the coronary circulation. The general circulation, it would indeed appear, can be much better carried on without the aid of the heart, than without that of the arteries; and this may be explained from the fact that the left heart is more frequently diseased than the right, and still less frequently are both diseased at the same time; so that, although the left ventricle cannot propel the blood when its parietes are ossified, the impetus given to the stream by the right heart is, along with the action of the arteries, sufficient to carry on the circulation, and life prolonged. It is for this reason "that we uniformly find when the ventricles are ossified, that the flesh of the auricle is firmer and stronger than usual."

Burns on the Heart, page 129.

Peculiarities of the coronary arteries.

The coronary vessels, both arteries and veins, I have already shown constitute a circulation which is not analogous to that of any other organ: the origin of the arteries at the commencement of the aorta, their orifices being so placed, and of such a form, as to receive the retrogade, as well as the refluent stream of the aortic blood; their course being such that the flow of blood in them can never be interrupted by the contraction of the muscular parietes of the heart.

The direct termination of the coronary veins in the right auricle, and in the right ventricle, are all peculiarities in the structure of these vessels, and the special functions of the organ they supply prepare us to meet with peculiarities in their pathological phenomena, and to find them executing an important share in the heart's diseases.

The foramina of Thebesius.

Prosecuting our inquiries into the pathology of the coronary arteries, there is a point regarding their anatomy which would be most important either to establish or to refute,—I allude to the termination of some branches in the left auricle ventricle, the presence of which has been demonstrated by some, and denied by other eminent anatomists.

The explanation which I have offered of the phenomena of congestion of the cavities of the heart and of the coronary vessels, seems to afford additional confirmation of the opinion of those who have asserted that branches of the coronary arteries terminate by open mouths in the left auricle and ventricle.

See page

I have endeavoured to explain by what means the economy regulates the quantity of blood within the heart, and how it is relieved from any undue quantity of blood by modifications in breathing. These processes, however, which relieve the cavities of the heart, do not appear calculated to diminish the blood in the congested coronary vessels; and to effect this purpose the peculiar arrangement of branches of the coronary arteries terminating in the left side of the heart may be assigned.

See page

Observations of Abernethy.

The ingenious observations of Abernethy, which were published many years ago, though they have never been, as far as I am aware, since alluded to, appear to me to throw much light upon this interesting subject.*

"There is a remarkable contrivance," he observes, "in the blood-vessels which supply the heart, not to be met with in any other part of the body, and which is of great use in the healthy functions of that organ, but which is particularly serviceable in preventing derangement of a part so essential to life."

A distended state of the blood-vessels must always impede their functions, and consequently be very detrimental to the health of the parts which they supply; but as the cavities of the heart are naturally receptacles of blood, a singular opportunity is afforded to its nutrient vessels to relieve themselves when surcharged by pouring a part of their contents into those cavities. Such appears to be the use of the *foramina*, by which injections, thrown into the blood-vessels of the heart, escape into the cavities of that organ, and which were first noticed by Vieussen, but being more expressly described by Thebesius, generally bear the name of the latter author.

Anatomists appear to have been much perplexed concerning these *Foramina Thebesii;* even Haller, Lenac, and Zirm, were sometimes unable to discover them; which suggested an idea, that when an injection was infused into the cavities of the heart the vessels were torn, and that it did not escape through natural openings. When these *foramina* were injected, they were found under various circumstances as to their size and situation; and Haller observed that the injection, for the most part, escaped into the right cavities of the heart. It also remains unexamined whether these *foramina* belong both to the arteries and veins, or respectively to each set of vessels.

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* "Observations on the *Foramina Thebesii* of the Heart," by John Abernethy. Philosophical Transactions, 1798.

It is from an examination of these openings in deseased subjects that a solution of such difficulties may probably be obtained. Whoever reflects on the circumstances under which the principal coronary vein terminates in the right auricle of the heart, will perceive that an impediment to the flow of blood through that vessel must occasionally take place; but the difficulty will be much increased when the right side of the heart is more than ordinarily distended, in consequence of obstruction to the pulmonary circulation. Indeed, is seems probable that such an obstruction, by occasioning a distended state of the right side of the heart, and thus impeding the circulation of the nutrient vessels of that organ, would as necessarily occasion corresponding disease of it, as an obstruction to the circulation in the liver occasions disease in the other abdominal viscera, were it not for some preventing circumstances; which I now proceed to explain.

Having been attentive to some very bad cases of pulmonary consumption from a desire to witness the effects of breathing medicated air in that complaint, I was led to a more particular examination of the hearts of those patients who died. In these cases I found that by throwing common coarse waxen injection into the arteries and veins of the heart, it readily flowed into the cavities of that organ; and that the left ventricle was injected in the first place, and most completely. When the ventricle was opened, and the effused injection removed, the *Foramina Thebesii* appeared both numerous, large, and distended, with the different coloured wax which had been impelled into the coronary arteries and veins. Upon eight comparative trials, made by injecting the vessels of hearts taken from subjects whose lungs were either much diseased, or in a perfectly sound state, I found that in the former, common injection readily flowed in the manner which I have described into all the cavities of the heart, but principally into the left ventricle, whilst in many of the latter I could not impel the least quantity of such injection into that cavity.

When explaining the nature of congestion of the heart, I have endeavoured to point out that it must be accompanied by a corresponding state of the coronary vessels, a congested state of the coronary *arteries* accompanying congestion of the systemic heart, and a congested state of the coronary *veins* accompanying a congested pulmonic heart; and the circumstance that the left is much more frequently diseased than the right heart is a proof that, notwithstanding the free anastomosis that subsists between them, only one of the coronary vessels may be diseased.

See page 401.

When investigating the symptoms arising from disturbances in the cerebro-spinal system, I alluded to some peculiarities in the distribution of the cerebral arteries in order to explain some of the morbid phenomena of the nervous system, and from the peculiar arrangement of the coronary vessels, it must in like manner happen that their disease will be the cause of numerous disturbances in the action of the heart. In these respects the coronary, like the cerebral arteries, from having a more regular supply of the vital fluid than most other arteries, and being also more quickly influenced by changes in the heart's circulation, will consequently be more susceptible, and participate in a greater degree in every disturbance of the action of the heart.

Coronary congestion.

Whenever there has been a congested state of the cavities of the heart, and a corresponding condition of the coronary vessels, it must not be concluded that a restoration of the heart's functions will always re-establish the healthy state of the coronary circulation; on the contrary, these vessels may in all probability continue more or less congested; and when the coronary circulation is disturbed, changes must take place in the tissues which these vessels supply. And where besides an increase of the muscular parietes the cavities of the heart are enlarged, and where the muscular tissues has likewise become pale and softened, the coronary arteries have been found much dilated.

Pathological inferences.

Contemplating the inflammatory affections of the heart, we are naturally led to inquire into the morbid conditions of the coronary vessels, as it is impossible to conceive that the capillary system of those tissues affected with inflammation should not produce some decided effects upon the whole system of cardiac vessels.

Diseases of the coats of the arteries.

That the coats of the coronary arteries are liable to *inflammation* like those of other arteries, is shown from morbid changes being found in them which are known to be the result of inflammatory action, lymph is effused upon the surface of their internal membranes, and the membrane itself presents the same reddened appearance or stain so common in other arteries.

The only disease of the coronary arteries which has created much inquiry is the *ossification* of their coats. These vessels are very often found ossified, particularly their orifices; but sometimes the ossific deposit is so complete, that they are converted into a bony canal. In old people nothing is more common than to find patches of bone over the whole extent; and it is probable that the ossification of these arteries is the cause of the syncope, so frequent in the aged, and which, when prolonged, often proves fatal. Besides dilatation, inflammation and ossification, in a few cases, an *aneurismal* swelling has been found in the coronary arteries, which has caused death from a rupture of their coats.

Diseases of the coronary veins.

In the heart, as in other organs, vascular congestion may either be arterial or venous, or both systems of vessels may be simultaneously congested. The *coronary veins*, by discharging their blood directly into the right auricle, the circulation will in them be modified in the various states of congestion of the *pulmonic* heart; but there never can be any regurgitation of the blood in these veins from the right auricle, in consequence of the valves with which these orifices are provided.

The coronary veins have usually been found *enlarged* where the muscular structure was changed; and it is highly probable that a congestion of blood in the veins of the muscles of the heart will modify their condition, in like manner as the muscles of the limbs become inert when the venous circulation in them is interrupted by wearing tight garments or applying a ligature on the limb.

Symptoms and Diagnosis.—Endeavouring to point out the changes in the functions of the coronary vessels from those of other parts of the heart's structure, I formerly remarked, that we are met with by insuperable difficulties. We can neither be assisted by the sense of sight, nor of feeling, nor of hearing, to detect any of these changes. There can be no alterations in the form or in the sensibility of the chest; nor can we conceive it probable that in the coronary vessels the currents of the blood could create sounds sufficiently loud not to be masked by those of the much stronger currents within the cavities of the heart. It cannot be denied that the symptoms of the diseases of the coronary vessels have not been hitherto discriminated from those of the morbid changes in the other tissues of the heart, especially from those of the muscles and serous membranes; and as the heart's functions, as well as those of its nutrient vessels are unlike the functions of any other organ, and the cavities of the heart constantly filled with a stream of blood, the circulation in the cardiac vessels must produce combinations of symptoms of which we have no analogy, and of which, I apprehend, from the present state of physiological and pathological science, we have not the means to reveal.

It has been already stated, that when both the coronary vessels and the cavities of the heart are *congested*, symptoms will be present, some of which are referable to the over-distended cavities, and others to the congested coronary vessels. But when the cardiac congestion is relieved, and the coronary vessels remain congested, the chief symptoms will be those caused by changes in the action of the muscular parietes; and if the action of the left ventricle be increased, the coronary arteries will be furnished with an increase of blood, although the force of the heart may not be adequate to propel the blood with its usual force into the arterial system. See page 417.

If the coronary vessels are healthy, when the heart's action is increased, they will receive a proportional increase of blood; but if these vessels are diseased, as they will not then receive any additional increase of blood, disturbances in the circulation must follow, and hence the paroxysms of syncope and uneasiness in breathing so frequent in those who have a diseased heart.

When the coats of the coronary arteries are diseased, it must often happen that the heart, not being supplied with its wonted quantity of blood, its muscles become pale and flaccid, and unfit to carry on vigorously the circulation; and consequently arise an assemblage of symptoms from an undue distribution of the blood, more especially to the cerebro-spinal system, symptoms See page 421.

to which the name of *angina pectoris* has been given; though, as I have formerly remarked, this term applies also to symptoms which arise from other changes of the heart's structure, besides those of the coronary vessels, and more especially from ossification of the valvular apparatus and aorta, so that angina ought more properly to be considered as a symptom than a distinct genus of diseases of the heart.

Treatment.—With regard to the treatment of the diseases of the coronary vessels, I have little to add to the observations which have been already made when treating of *congestion;* I may, however, again allude to the beneficial influence of local blood-letting in that condition of the heart, the curative effects of which I endeavoured to explain, from the free anastamosis existing between, not only the coronary arteries with one another, but also from branches of the coronary vessels supplying the pericardium, and inosculating with the internal mammary arteries.

See page 426.

The abstraction of blood by *leeches,* applied on the precordial region,—a practice which is so beneficially resorted to in cases of congestion, and in cardiac diseases of an inflammatory type,—produces its curative effects, in all probability, by its influence on the coronary circulation; and this explanation applies generally, I apprehend, to the administration of other remedies when successfully employed in many of the heart's diseases, especially to those which have so powerful an effect in subjugating the heart's impulse, and also to those which change the qualities of the blood.

Whatever system of treatment it may be judicious to adopt in the early stages of those affections which ultimately produce changes in the tissues of the heart, it is clear that when such changes have taken place, these principles of treatment become quite inapplicable, and those means only can, with propriety, be now adopted which relieve particular symptoms. There are some remedies which, however beneficial they may be in those acute forms of disease that precede structural changes, their use is to be equally guarded against in the advanced stages of organic disease. Of such I would particularly mention mercury and antimony. Thus, to correct any disturbance of the biliary secretion, which may accompany the organic affection, an occasional dose of *mercury* may be proper; but the poisonous effects of that mineral on the action of the heart whenever it has been absorbed into the blood, is always injurious. So, likewise, as regards the preparations of *antimony*—the influence which these have in diminishing the heart's vigour, renders their administration more or less dangerous, when, from any organic changes of the heart's apparatus, the circulation of the blood is much obstructed.

In the treatment of the diseases of the coronary vessels, as of all the organic affections of the heart, attention should be directed to those means which prevent the circulation being disturbed; for it is quite evident that from whatever cause the action of the heart is increased, there will also be an increase in the circulation of the coronary arteries. Hence the danger of passion, or of any unusual bodily exertion, and the propriety of observing mental and bodily tranquillity, along with the absence of all stimulating food or drink.

Speaking of *angina pectoris* (and the observation applies in general to all organic affections of the heart), Burns judiciously observes:—"In this, as in most other affections of this organ, we must abstain from the use of *stimuli;* the patient, if he does more than merely regulate, must take the responsibility upon himself. Few, however, until too late, can be persuaded of the necessity of self-denial; and few will submit to the privations which, in this complaint, are indispensably necessary."

The treatment to be adopted, during a state of *syncope*, in those suffering from angina, the same distinguished author observes:—

"During a paroxysm of syncope, we are, even though the pulse is weak and faltering, to abstract a few ounces of *blood;* for, sometimes, the heart is prevented from beginning to act again by the blood with which it is overloaded. In this state of matters, by opening the jugular vein, and gently pressing on the chest, we endeavour to expel a portion of blood from the right side of the heart, for the very same reason that we employ the lancet in suspended animation.

"Cold application to the head and chest should also be employed; and, when the breathing begins, and the patient, after a long interval, fetches a deep convulsive sigh, *ammonia* may be held to the nose, or given in the stomach, combined with aromatics; and, for the same purpose, artificial respiration may be resorted to.

"But while the person is in either a state of actual fainting, or just recovering from this condition, let the practitioner be aware of the effects of the exhibition of stimuli, with the view of rousing the patient. By these, the heart just beginning to emerge from the temporary cessation of function, will be made to show, for a short time, signs of returning animation; but the hope is delusive, for speedily it falls into its former state, and from which no stimulant, however powerful, can again recall it."

Burns on the Diseases of the Heart, p. 180.

CHAPTER XXIX.

MORBID CHANGES OF THE PERICARDIUM.

Morbid changes of the pericardium; inflammation; effusion of a sero-albuminous fluid; deposits of fibrine; adhesions; deposits of a cretaceous matter, and of bone; blood and air in the cavity of the pericardium; dropsy of the pericardium; total absence of the pericardial fluid; pericardium altogether wanting; tubercles.

The pericardium presents all those changes of structure which are met with in other sero-fibrous membranes.

When *inflamed*, the pericardium loses its transparency, and is increased in thickness. Its serous tissue is injected with red vessels, and infiltrated with a yellow, opaque, and sometimes with a sanguineous fluid, and its subjacent fibrous tissue may be implicated in the inflammatory attack. Inflammation.

Inflammation of the pericardium is followed, sooner or later, by the effusion of *fibrine* upon its serous surface; and a sero-albuminous, and sometimes puriform fluid, is deposited in the pericardial cavity. Effusion of fibrine.

The fibrine varies in consistence and in quantity. It is usually found spread over the whole surface of the membrane; loose threads of it float in the watery fluid, and masses attached to each other give it a honey-comb appearance. Sometimes the quantity of fibrine is so great as to fill up the space between the surface of the heart and the exterior portion of the pericardial sac.

When not absorbed, after the inflammation has abated, the fibrine gradually acquires a greater degree of firmness, becoming a distinct plastic lamina, and ultimately a dense fibro-cellular structure, by the medium of which *adhesions* are formed between those portions of the capsule of the heart which are opposed to each other. The newly-formed lamina is easily separated from the Adhesions.

subjacent serous-membrane, and "there is frequently to be seen in it a slight red appearance from small blood-vessels ramified through it; but they are most distinctly seen by filling them with fine injection; they are sometimes numerous, and may be traced passing from the pericardium into the pulpy matter."

Baillie.

Between the adventitious lamina of fibrine and the serous membrane, there is not unfrequently a cretaceous matter deposited, which is in all probability *urate of soda*, that salt which I have formerly pointed out to be characteristic of *arthritic* inflammation.

See page.

The fibrous lamina of the pericardium likewise participates in the inflammation of the superincumbent serous and sero-cellular tissues, and is also liable to distinct changes, of which the *cartilaginous* and *osseus* masses so frequently found underneath the serous lamina afford examples.

The "hæmorragic exudation" of Lænnec.

Besides these morbid changes, the effects of various degrees of inflammation, *blood* has been sometimes found effused in the cavity of the pericardium, not accompanied with any change in its structure, but connected with some constitutional disorder.

Dropsy of the Pericardium.

The pericardial fluid, like that of other serous cavities, is also liable to be morbidly increased; and the membrane, at the same time, loses its transparency, and is increased in thickness. The pericardial fluid, in place of a transparent serum, becomes more or less discoloured and opaque, and it accumulates in various degrees. Indeed whenever a heart is diseased, there is usually water in the pericardium before it proceeds to a fatal termination; the water accumulating at the same time in the cavities of the pleura and in the subcutaneous cellular tissue.

Anasarca.

In a few instances no moisture has been found in the pericardium, the serous surface being perfectly *dry;* in other instances a considerable quantity of *air* has been accumulated in the pericardium, and the pericardium has also been altogether wanting.

Baillie.

Besides these several morbid appearances of the pericardium, scrofulous, schirrhous, hæmatoid and melanoid *tubercles* have each been occasionally met with growing from the serous capsule itself, as well as from the subjacent structures.*

Symptoms.—Reviewing these morbid changes of the pericardium, we at once perceive how difficult, indeed how impossible it must be to assign to each of them any particular spmptoms; and the pericardium being common both to the pulmonic and systemic heart, its diseases must be liable to influence the venous as well as the arterial circulation.

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* The concretions of the sero fibrous membrane of the heart, which were analysed by Brand, were found to consist of phosphate of lime with "earthy matter."

Formerly I endeavoured to point out the symptoms of pericarditis, and to show how little confidence could be placed in the physical signs which some pathologists have pointed out as characteristic of that disease, especially the impossibility of a sound of "friction" being produced by the rubbing together of pieces of lymph deposited on the surface, and floating in the cavity of the pericardium. It is therefore the physiological symptoms and the history of the disease upon which reliance can alone be placed in forming a diagnosis of the different morbid changes of this membrane. See page.

CHAPTER XXX.

MORBID CHANGES OF THE ENDOCARDIUM.

Morbid changes of the endocardium; their importance in the catalogue of the heart's diseases; its morbid changes analogous to those of other serous membranes; inflammations; their specific character; redness from an increased vascularity, and from imbibition; effusion of fibrine on the surface, and in the subserous cellular and fibrous tissues; cretaceous and ossific deposits; ulcers; warty excrescences, and polypi; moveable bodies and tubercles; changes in the structure of the valves; value of physical signs; diseases of the semilunar valves of the aorta; phenomena which accompany the diseases of the valves; the unphilosophical opinions of the cause of the sounds; acoustic and hydraulic phenomena confounded; diseases of the semilunar valves; diseases of the mitral valve; diseases of the tricuspid valve; difference in the general characters of the diseases of the right and left heart; peculiarities in the structure, functions, and diseases of the tricuspid valve.

THE morbid changes of the *endocardium* are, perhaps, of far more importance than those of most of the other tissues, the diseases of the lining membrane of the auriculo-ventricular cavities, with their valves and columnæ, having a great influence in all the disturbances of the heart. "It is not exaggerating," observes Bouillaud, "to affirm, that the diseases of the endocardium are the points from which most usually commence all the affections of the valves, of the parietes, and of the cavities of the heart."

Similar morbid changes are found in the endocardium of each heart, though the lining membrane of the right is much less frequently diseased, than the lining membrane of the left heart. Neither is every portion of that membrane in each heart equally liable to become diseased, those parts which are thin and transparent being least frequently changed.

The endocardium is liable to those morbid alterations of structure which are common to the serous tissues ; yet there are also peculiarities which arise from the purposes it is destined to fulfil in the economy, that membrane having a highly polished surface to facilitate the stream of the vital fluid, to the contact and influence of which it is constantly exposed. Neither does the endocardium appear, like other serous membranes, to have any exhalation from its surface, such, from its smoothness, not being required to facilitate the transit of the blood.

Of the morbid changes of the endocardium, the most common are those produced by *inflammation.* All the inflammatory affections of this tissue, I have already endeavoured to point out, Page 488. are of a specific character, being referable either to gout, rheumatism, or to the exanthematous diseases.

The membrane when inflamed becomes injected with red vessels —an appearance which ought to be carefully discriminated from redness which is caused by the *imbibition* of blood. The circumstance of the lining membrane of the whole arterial system being always in immediate contact with the blood, blood is imbibed, and the membrane becomes stained. A similar change is observed also in other serous membranes ; these imbibing the fluids they contain ; a striking example of which is seen in the gall-bladder, when the bile, oozing through its parietes, stains its peritoneal covering.

Besides an increase of vascularity, *fibrine* is effused on the surface of the inflamed endocardium, and the inflammation extends from the serous membrane to the sub-serous cellular and adjacent fibrous tissues. These lose their transparency, are thickened and indurated, becoming the seat of *cretaceous* and of *ossific* deposits, especially in the valvular apparatus ; and from the contiguity of the pericardium to the endocardium in some places, the two membranes are sometimes blended together, so that they cannot be separated.

In diseases of the heart's parietes, such as in aneurism and dilatation, to prevent the walls from bursting, a concreted and vascular limina of fibrine, resembling that which lines the sac of an aneurismal artery, has been found effused on the surface of the Hodgson. endocardium.

Sometimes, though rarely, *ulcers,* and likewise *warty* excrescences have been met with on the vascular portion of the lining membrane, and *polypi* have been frequently observed in the cavities of the heart, these consisting chiefly of organized fibrine, having a vascular connection with the endocardium. In one case, a *moveable body*, analagous in structure to those found in the synovial capsules in the vaginal coat of the testes and in the cavity of the pleura, was found in the ventricle; and scrofulous, schirrus, hæmatoid, and mœlanoid *tubercles* are also occasionally formed in the different portions of this membrane.

* Wood.

Changes in the Structure of the Valves.

The morbid changes of the lining membrane of the cavities of the heart, are most remarkable on those portions which, by their duplicatures, form the valves; changes in thickness and hardness, the formation of warty excrescences, and of ulcers, all producing most important alterations in the direction of the currents of the blood as it passes through the cavities of the heart.

Disregarding the endless disputes and the unphilosophical theories that have been formed in endeavouring to explain the cause of the heart's sounds, and the no less discrepancy in the opinions that have been offered on the character of the sounds accompanying particular diseases of the heart, it must, however, be admitted, that in none of these diseases are the physical signs of more assistance in forming a correct diagnosis than in those of the valvular apparatus.

As the characters of the two audible sounds depend on the integrity of the valves, we are naturally led to examine the changes of these *sounds* when investigating the diseases of the heart; and we are also led to inquire into those structural changes by which the new sounds are produced. Let us therefore review those physical signs that accompany the diseased changes in the different compartments of the heart; but at the same time, during this inquiry, we must not lose sight of the various physiological symptoms and history of the disease before venturing to pronounce an opinion of its true character, and more especially before attempting to point out the principles on which the most appropriate treatment should be conducted.

Diseases of the Aortic Valves.—The essential difference in the office of each of the valves prepares us to meet with very different effects upon the circulation in their diseases.

By far the most important of this part of the heart's apparatus are the *semilunar valves* of the aorta; for, as the health of all the organs depends upon receiving a due supply of the vital fluid, any obstruction to its free exit from the heart into the canal of the aorta must materially influence and derange the functions of life.

When the semilunar valves are so much thickened and indurated as not to permit the blood to pass from the left ventricle into the aorta in its wonted stream; and when the valves are so changed in their form that they cannot be closed sufficiently to stem the retrograde current of the aortic blood; the left ventricle then becomes congested, the left auricle and pulmonary veins are gorged with blood, and oppose the current from the pulmonary artery.

Symptoms.

A remarkable assemblage of phenomena accompanies this condition of the heart. The respiratory function is deranged from the engorgement of the lungs, and the diminished supply of arterial blood to the cerebro-spinal and cutaneous systems causes various uneasy sensations, along with paleness and coldness of the skin and extremities.

Changes in the impulse,

Besides the effects of a diminished stream of the affluent blood, the stream of regurgitating blood produces changes in the impulse and in the sounds. The heart beats irregularly, its impulse is sometimes violent, and at other times almost imperceptible; the radial pulse is small, intermittent, undulatory, bounding*, unequal and jarring, all which changes are increased by locomotion.

and in the first sound.

When the aortic valves become diseased, the *first* sound is changed by the obstruction to the stream of blood through the contracted orifice of the valves, and it becomes a blowing murmur, or whizzing thrill; but the character of this sound is materially altered when there is also a current of regurgitating aortic blood, or when the structure of the mitral valve is at the same time changed, or when there is a change in the valvular apparatus of the pulmonic heart.

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* "I have many times been able to say, by feeling the pulse, that there was ossification in the membrane of the heart. I distinguished it by a sort of *bound* in the pulse."—*Abernethy's Lectures.*

Erroneous explanation of sounds.

When explaining the sounds of the heart, I endeavoured to show that they were caused by the two great currents of the blood; the one which passes from the auricles into the ventricles, and the other from the ventricles into the arteries; and that alterations in these two currents, caused by morbid changes in the heart's structure, produced various alterations in the character of the sounds, and even produced new sounds. This explanation of the cause of the sounds of the heart is, however, directly opposed to the opinions of those who have attributed sounds to "the flapping of valves," and who have employed a chain of reasoning, and made experiments to show the effects of *currents of air*, in order to explain the effects of currents of *blood*; thus applying the laws of acoustics in place of those of hydraulics, for the explanation of the heart's sounds.* Indeed the changes in the sounds which accompany an indurated and unyielding valve, would, it might have been anticipated, have precluded so unphilosophical an explanation ever to have been offered.

See page 8.

Case.

A gentleman in the twenty-fifth year of his age, some branches of whose family had suffered from *gout*, had a severe attack of what was considered as *rheumatism* in one knee, which left him suddenly. The following year his breathing became quickened, and the heart's impulse increased, which symptoms were accompanied by a sense of oppression at the chest, and a slight œdema of the extremities. These symptoms gradually increased, and he died fifteen years after the commencement of the disease.

Case.

The semilunar valves of the aorta were ossified and agglutinated together in such a manner as to leave a very small aperture for the transit of the blood. Fig. 14 represents a section of the aorta close to the ossified semilunar valves, and also the great diminution of the valvular orifice.

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* "It is the *tympanitic* sound of the membranous valves which, with the time of the beats, produces the rhythm, and we judge of the existence of certain states of disease by the degree and manner in which they are *out of tune*."—*Billing*.

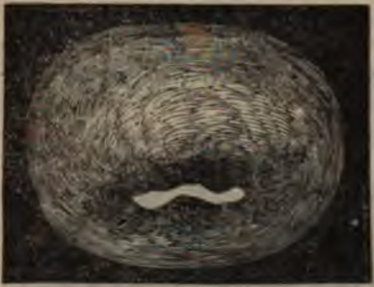

Fig. 14.

Diseases of the Mitral Valve.—Sometimes this valve become so thickened, and its aperture so much constricted, as not to permit the blood of the left auricle to pass freely into the left ventricle. This condition of the mitral valve often accompanies a diseased state of the aortic valves.

In twenty-nine cases of valvular disease, examined by Forgeot, in nine the aortic valves were alone affected, in ten the mitral, and in the remaining ten both aortic and mitral.

When the mitral valve is alone diseased, and its aperture contracted, there must not only be a diminution in the stream of blood which enters the left ventricle, but when this valve does not close accurately, there must also be, on the ventricle contracting, a regurgitating stream of blood from the ventricle into the auricle. A change will therefore necessarily take place in the *second* sound. In proportion as the vital stream into the left ventricle is lessened, so must the circulation through the whole arterial system be diminished, and the left auricle and pulmonary veins will become congested and dilated from the regurgitated blood.

A young countryman suffered from great difficulty of breathing and occasional hæmoptœ. The "saw sound" was very remarkable; and for some months previous to his death, he was himself in the habit of hearing a noise when in bed, like the Case.

barking of a dog, as if at a neighbouring farm-house. After death, water was found in the left chest, large portions of the lung apoplectic, and the left auriculo-ventricular orifice contracted, its diameter not being larger than the trunk of the common carotid artery.

From M. Kiernan's Collection.

Fig. 15 represents a section of the left auricle, showing the diseased mitral valve and the contracted auriculo-ventricular orifice.

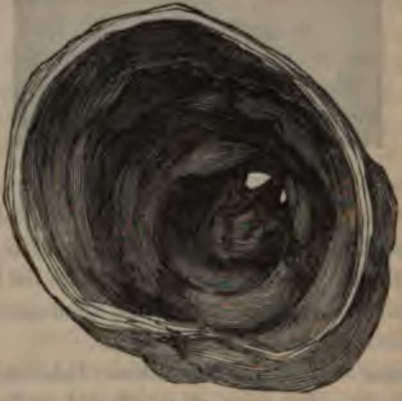

Fig. 15.

Diseases of the Tricuspid Valve.—The diseases of the valves of the pulmonic are much less frequent than those of the systemic heart. "Of twenty-nine cases of valvular disease, the tricuspid was found changed only in one case, and in none was the semilunar valves of the pulmonary artery detached." It appears, indeed, that the acute or inflammatory affections attack chiefly the left heart, while the right is more the seat of chronic ailments.

Forgeot.

In a former part of this work I pointed out at some length the difference in the structure and functions of the two hearts, especially of their auriculo-ventricular valves; that valve in the systemic heart completely preventing any regurgitation of the blood into the auricle on the contraction of the ventricle, whilst the valve of the pulmonic heart is so constructed, that when the ventricle is distended, and its walls forced to yield beyond a certain limit, the valvular aperture is then widened, and a free communication established between the auricle and the ventricle. Hence when that portion of the endocardium, the duplicature of which forms the tricuspid valve, becomes thickened, and the parietes of the right ventricle are so much thickened that they cannot sufficiently yield to permit the blood to regurgitate into the auricle, the valve then becomes unable to perform the function of a "safety-valve," for which purpose it is assigned; and various irregularities arise in the *venous* circulation.

See page 110.

Symptoms.

Symptoms.

An interruption to the circulation in the *left* heart being characterized by changes in the arterial circulation, a derangement in the venous system is equally characteristic of a disturbance in the circulation of the *right* heart. The congested state of the pulmonary vessels causes a difficulty and oppression in respiration, and the turgescence of the veins of the head renders the intellectual powers sluggish and inert; the portal system also becomes turgid,—a condition which is frequently relieved by the hæmorrhoidal flux.

Changes in the impulse,

The changes in the currents of the blood caused by a diseased tricuspid valve, produce changes in the heart's *impulse*, the congested state of the right ventricle which accompanies the valvular disease increasing the force of the ventricular contractions, which increased action must influence the circulation in the pulmonary artery; and therefore we find that it is only in diseases of the systemic heart that changes take place in the *arterial* pulse.

and in the sounds.

When the passage of the blood from the right auricle to the ventricle, or when the regurgitation of the blood is impeded, the second *sound* of the heart is changed, assuming different characters according to the condition of the tricuspid valve, and likewise of the surrounding parts.

In such complicated cases various alterations must necessarily take place in the currents of the blood, and consequently in the sounds of the heart, such as we cannot suppose could be discriminated by the human ear. With this impression, we are compelled to doubt the accuracy of many of those signs that have been pointed out as appertaining to particular alterations in the heart's apparatus; and I am inclined to suspect that some of those physical signs, described with so much pedantic accuracy, have not always been the result of actual observation, but the offspring of fertile imaginations,—an opinion corroborated by the numerous errors in diagnosis made by those who place their chief reliance upon physical signs.

Difficulties of the diagnosis.

When we contemplate the great number of the organic diseases of the heart, their various stages, their duration, the numerous tissues, the different portion of each tissue which may be affected, and their combinations with the diseases of other organs, we need not indeed be surprised at the difficulty in distinguishing the organic diseases of the heart from one another.

The difficulty is still further increased when we consider that there is scarcely one symptom of those organic diseases, physiological or anatomical, which is not to be met with in the functional diseases of the central organ. Nevertheless, an accurate knowledge of the physiological and anatomical symptoms, along with the history of the disease, will in many instances enable a correct opinion to be formed of its nature and general character—an opinion of far more importance as regards the treatment that should be adopted, than any remedial means suggested merely from a knowledge of some minute changes which may have taken place in the structure of the organ. How much more rational would a system of treatment be in a case of gouty affection of the heart, founded on the principle of treating gout *generally*, than based upon the knowledge of a disease of any particular portion of the serous membrane of the heart.

These remarks strictly apply to the diseases of the endocardium, as there are but few symptoms which can be said properly to belong to each of them. The only step which can with confidence be taken to distinguish a disease of the lining membrane of the heart, is to determine whether it be the endocardium of the pulmonic or of the systemic heart.

See page 184.

Treatment.—As regards the treatment of the organic diseases of the endocardium, I have little to add to what has been already said when considering "The Treatment of the Diseases of the Heart in general," and also to the observations that have been made on the treatment of the inflammatory affections of the endocardium.

Chap. viii.

As it is extremely probable that more or less inflammation may, during the progress of the organic changes of the endocardium, occasionally supervene, the presence of such inflammation should always be taken into consideration when any system of treatment is adopted; and my impression is, that the benefit so often derived from the preparations of *iodine*, *colchicum*, and *iron*, in this class of ailments, is produced by the influence of these medicinal substances on the *arthritic* and *rheumatic* inflammations which accompany the changes in the structure of the valves, and also in promoting the absorption of the lymph that has been effused on their surface and on the subserous cellular tissue.

Besides the use of such remedies as may subdue any inflammatory condition of the endocardium, all those means should be employed which diminish the vigour and irritability of the heart, compatible with the functions of life.

For this purpose *neurotics* cautiously administered may be had recourse to; but serious consequences follow when that class of medicines are given in too large doses — doses sufficient to diminish so much the power of the heart, that when from the mechanical obstruction to the circulation caused by diseased valves, the heart is unable to circulate the blood. It is under these circumstances that fatal effects have arisen from the injudicious use of *digitalis*, *hydrocyanic acid*, and *chloroform*.

During one of the paroxysms of *syncope*, so frequent in those suffering from diseases of the lining membrane of the heart, the heart having then become congested and unable to propel the blood, the abstraction of a small quantity of blood from a vein, as the external jugular, may be employed; which, along with the application of stimuli to the sneiderian membrane and cutaneous surface, will assist the heart to carry on the circulation. The vital element must, however, be in such cases taken away with much caution; for, as I observed when considering the effects of *neurotics*, if more blood happens to be removed than is consistent with the continuance of the action of the heart, life may be instantly extinguished. Page 517.

Analogous to the effects of blood-letting, is *dry-cupping* on the chest, or back of the neck; a remedy which may always be unhesitatingly employed. Page 394.

In the treatment of the organic affections of the heart, it is always essential to adopt all those measures which will prevent the circulation being accelerated; and such means are more especially applicable in those cases where there is a morbid change of the valves. The processes of *incretion* and of *excretion* should be carefully regulated by due attention to diet, and the judicious use of purgatives. *Locomotion* should be guarded against, especially any immoderate muscular exertion; and all mental excitement is equally inadmissible; for, in the more aggravated form of valvular disease, death has in many instances immediately followed a violent muscular effort or mental emotion.

By employing these different remedial agents, and judiciously adapting them to each case, it is surprising how long the lives of those suffering from diseased valves have in many instances been prolonged; and therefore, because there are many diseases of the heart which cannot be cured, we should not the less value those means by which they may be alleviated. "There is no disease, however hopeless, that does not admit of some mitigation, if not suspension, when managed according to the dictates of experience and sound pathology." Forbes.

CHAPTER XXXI.

MORBID CHANGES OF THE MUSCLES OF THE HEART.

Morbid changes of the muscles of the heart; peculiarities in the structure, functions, and diseases of the heart's muscles; the morbid changes of the muscular tissue enumerated; augmentation of the muscles; objections to the terms that have been employed to designate this condition; the diseases of the heart which cause an increase in the muscles; symptoms arising from this state of the heart's muscles; diminution of the muscular tissue; softening of the muscular tissue.

Before entering upon the investigation of the diseases of the muscles of the heart, we are first led to consider the nature of the functions which these muscles are destined to perform, and also endeavour to reveal peculiarities in their organization by which they are enabled to execute an office in some respects unlike that of other muscles. And when we reflect, that of all the vital organs the heart is perhaps the only one the functions of which cannot permit even a momentary interruption in its movements compatible with life, we may expect to find that there are peculiarities in the structure and also in the pathological conditions of its muscles,—peculiarities some of which have not yet been satisfactorily explained by the most diligent inquirers.

Peculiarities in the structure of the heart's muscles.

The muscular fibres of the heart exhibit the characters both of voluntary and involuntary muscles, some of them being *plain* and others *striped*. The small quantity of cellular tissue interposed between the fibres, their deep red colour, the proportionably larger size of their arteries when compared to those of other muscles, are all striking peculiarities in their anatomical structure.*

In their functions, the heart's muscles are remarkable not only for their unceasing action during the whole span of life, but for their rythmic contractions not being interrupted, even after the cardiac nerves have been divided, or the blood evacuated from the heart's cavities,—a phenomena which continues in some races of beings after the heart has been for some hours removed from the body. It may therefore be truly said that "the motion of the heart appears to be innate, coming neither from the brain nor the blood." Bichât.

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* "Even after death," observes Hunter, "we seldom see a dead body that is not stiff, but we very often find the heart large and flabby."

These peculiarities in the structure and functions of the muscles of the central organ of the circulation cannot fail to have a decided influence in the character of its diseases, and must surely be sufficient to point out how the heart's disorders will not be like those of any other organ. Thus we find that its muscles are never paralysed either in *hæmophlegia* or in *paraphlegia;* and Bichàt was of an opinion that as only the muscles of locomotion are liable to convulsions, probably the heart is never affected with *convulsive* movements. I have already mentioned that the heart's muscles, as well as those of all the other organs of organic life, appear to be exempt from *rheumatism,* as an attack of that affection could not fail instantly to prove fatal. It may, indeed, be observed that throughout the whole animal creation means are provided to protect the different organs from diseases as well as from injuries, and these means are multiplied in proportion to the importance of their functions. Some are defended from atmospheric agencies by an external covering, or integument; some by osseous parietes; some by bony canals; and some are in pairs, so that if one be injured, the other is sufficient to perform the function. From whence it appears legitimate to infer that the heart of all the vital organs will be possessed of an organization, not only to protect it from injury and to secure the uninterrupted circulation of the blood, but that it shall be endowed with a structure to render it exempt from some maladies that are met with in other organs.

"Anatomie Pathologie."

See Page 526.

Morbid changes of the muscular tissue.

But whilst the heart is not liable to some of those diseases, an attack of which would immediately interrupt the circulation of the blood, its muscular tissue is, from the peculiarity of its structure and functions, more subject to certain ailments than perhaps any of the other muscles of organic life.

The more remarkable changes in the muscular tissue of the heart are a preternatural *increase* and a *diminution* in the quantity of the muscular fibres, an alteration in their *consistence* and in their *colour*, the effusion of *blood*, and the formation of *abscesses* and of *bone*, in the interstitial cellular tissue. Although morbid growths are rarely met with in the muscular system, *scrofulous*, *schirrhous*, *hæmatoid*, and *melanoid* tubercles, are found in the parietes of the heart; some being formed in the muscular, and others in the fibrous lamina, both of the pericardium and of the endocardium. Deposits of *bone* and cysts filled with a *cretaceous* matter are not unfrequently found in the muscular parietes of the heart, and these usually in gouty subjects; and the muscles of the heart, like other portions of the muscular system, are also converted into *fat*, and into a matter resembling *spermaceti*.

Increase of the Muscular Tissue of the Heart.

Increase of the muscular fibres.

Of all these changes, the most frequent is a preternatural increase in the number of the muscular fibres, or an enlargement of the parieties of the heart.

All the voluntary muscles increase in size in proportion to the frequency of using them, in like manner as they diminish when they are seldom brought into action; but the same change is not met with in the involuntary muscles, unless when the organs to which they belong are diseased. This probably arises from the circumstance that when an organ into the composition of which there is a muscular structure, becomes diseased, as the urethra and alimentary canal, more powerful muscular contractions being required to propel the contents of the bladder and intestine, the number of their muscular fibres are increased. This change takes place in the muscular tissue of the heart when an increased vigour of its parietes is necessary in order to overcome an hindrance to the free passage of the blood through its cavities. An increase of the muscular tissue in such cases seems therefore to be a process of the economy—of the *vis conservatrix*—by which certain organs, when they have become changed in structure, are yet enabled to perform more or less perfectly their respective functions.

Different names assigned to it.

An increase in the muscular parieties of the heart, though it had been long noticed, was first considered and treated of as a distinct disease by Dupuytren, by whom it was denominated "nutritive irritation," and by Corvisart "passive aneurism." Afterwards Læunec called it "hypertrophy," a name signifying an "increased nutrition," and which term has since been employed to express not merely an enlargement of the muscles of the heart, but, used in a generic sense, to designate an increase in the bulk of other tissues. An "increase of the nutrition" of a tissue cannot surely be considered as a *disease* or a morbid process. The function of nutrition is constantly varying in every organ, like all the other functions of organic life; so that it is an abuse of language to say, that when the bulk of a muscle, or of a bone, or of the adipose tissue, is preternaturally augmented, it is a disease to which the name of *Hypertrophy* is appropriate. Indeed hypertrophy is a term which appears to me very objectionable, being in no respect preferable to those formerly employed, and equally ill-calculated to denominate a genus of diseases, as headache, cough, tenesmus, or palpitation; these terms merely expressing *symptoms*, and symptoms too which are present in almost every disease of the head, of the heart, and of the alimentary canal.

These names objectionable.

Causes which increase the muscular tissue.

There is no disorder in the heart's muscles more frequent than an increase in their action, and the increased action produces an increase in their bulk; but this increased action must continue for a lengthened period before the muscular parietes of the heart are increased in thickness, if we are to judge from what takes place in other muscular sacs, such as the bladder of urine. At the same time, the heart's muscles, having no repose, their bulk may be more rapidly increased than that of most other muscles.

An increased action of the muscles of the heart, and the subsequent augmentation of their fibres, may be produced by several distinct causes.

When either the pericardium or the endocardium is inflamed, the contiguous muscular tissue becomes irritated, and the action of the heart increased. And whenever either the heart's cavities or the coronary vessels become *congested*, the muscular parietes are preternaturally excited, the force and frequency of their contractions being augmented in proportion to the difficulty of circulating the blood; and the action of the heart is frequently very much increased by changes in the *qualities* of the blood.

A congestion of the *coronary* vessels will, I am persuaded, in many instances account for cases where there has been an increased bulk in the muscular parieties of the heart without any other alteration in its structure. To this conclusion I have been also led from the mode of treatment by which they may be relieved; and it seems to me extremely probable that cases alluded to by that acute anatomist John Bell, were of that description.

"The *heart*, which is so often *dilated* by weakness, is sometimes *reduced* in *size* by an increase of strength and action. It becomes dense, firm, thick in substance, but small in its cavity; it appears to be dilated without, but is in fact contracted within. This thickening of the walls of the ventricles is what I cannot understand, though I have cut many such hearts with the utmost care. There is no ossification of the valves, no straightening of the aorta, nor any other obstruction to excite the heart. There is no enlargement of the auricles, no dilatation of the veins, no disease of the arteries; nothing appears but a thickening, and enlargement, and condensation of the walls of the ventricles, a proportioned enlargement of the columnæ carnæ, and a proportioned narrowing of the cavity of the heart itself. Upon opening such a heart, one would almost pronounce it natural. If one should speculate upon its peculiarities, they would (finding the heart strengthened, and its valves and vessels all sound) pronounce that it would cause rather a vigorous circulation and strong health; yet I shall never forget the miseries I have seen patients endure from having such a heart. They have often a full and bloated habit of body; a pulse weak at all times, but trembling, and hardly sensible, when a fit of difficult circulation approaches; then the pulse vanishes; the patient sometimes faints; the anxieties, oppressed breathing, languid pulse, actual fainting, and all the intermediate conditions less than fainting, but like it, and infinitely more miserable, make their chief sufferings. After struggling long under this disease, the patients grow languid for a few days, often become dropsical, and then die.

"The variety of symptoms which those suffer who have this simplest of all the diseases of the heart is very surprising, and puts to nought all our conjectures about certain signs indicating particular diseases of the heart. We cannot be surprised that in great enlargements of the auricles, or vast aneurisms of the aorta, or in those enlargements in which something like polypi are found, and where, as Mr. Holder often said of himself, the circulation seems to go on for a time at one corner, as it were, of the heart; in all such cases, we cannot wonder at their being heard noises like the rushing of water in great cisterns. But how such should be heard in this thickening of the heart, I cannot conceive; yet surely enough one gentleman, whose disease came upon him all at once, and while perfectly at rest, with the sudden sense of something bursting within,—who had, moreover, for several years a palpitation which could be felt outwardly, and a plunging noise, which at times the by-standers could hear very loud; who died in the end in great distress,—had yet none of these ossified valves, enlarged aorta, nor other organic affections, which there was so much reason to suppose, but merely this thickening of the substance of the heart."

John Bell, Anatomy.

But a long continued increased action of the muscular parietes of the heart, followed by an increase in their bulk, is most frequently caused by a mechanical interruption to the free transit of the blood through the auricular and ventricular cavities, such obstructions being the effects of a morbid change in some portion of the valvular apparatus.

When the muscular tissue is increased in bulk, that increase is met with in different portions of the heart, according to the site of the obstruction to the circulation, and it may either be in the parietes or in the fleshy pillars of the valves where there is an augmentation of muscular fibre. The increase of the muscular tissue is chiefly met with in the ventricles; and more frequently, and to a greater degree, in the systemic than in the pulmonic ventricle, the walls of the left ventricle sometimes acquiring more than double their natural thickness. And when there is an increase in the bulk of the muscles, sometimes there is a diminution and sometimes an increase in the cavities of the heart.

Symptoms.—Reflecting on those symptoms, both physiological and anatomical, which accompany an increase in the muscular parietes of the heart, it will at once appear that as an increase of muscular fibre is not a *primary* disease, but the effect of a morbid condition of some portion of the structure of the heart, or of some change in the quantities or qualities of the blood, the assemblage of symptoms must be varied by that disease with which the changes in the muscles is accompanied. Thus an increase in the muscular fibres is occasioned by a long-continued source of irritation, by a vitiated blood, or by frequent and protracted nervous excitement, by a mechanical hindrance to the passage of the blood through the heart's cavities; in each of these cases the increased bulk of the muscular parietes will be attended with symptoms essentially different from one another.

The symptoms arising from an augmentation of the muscular tissue will also vary according to the portion of the heart's parietes which is affected. If it be those of the systemic heart, we may look for those caused by an irregular circulation of the arterial blood; and if it be those of the pulmonic heart, an assemblage of symptoms will be produced from irregularities in the venous circulation.

To discriminate the portion of the heart's parietes the muscular fibres of which are increased, we must not expect that the local symptoms will give us sufficient information. The symptoms of a disturbed circulation of the pulmonic and of the systemic heart on the different systems of the economy will alone point out an accurate diagnosis.

When the walls of the heart are increased in thickness, there is a proportionable increase in the *impulse*, but from the increased thickening the intensity of the *sounds* is diminished. There is also a dulness perceptible on *percussion*, according to the degree and the extent of the increase in the bulk of the heart.

Treatment.—From whatever cause the action of the muscular parietes of the heart have been preternaturally increased, it is quite clear that the curative indications are to employ those means which tranquillize the action of the heart, in addition to such remedies as may be required, to alleviate the primary affection by which the increased action of the heart had been excited; and if we are able to remove the cause of the increased action of the heart, the number of its muscular fibres will diminish, in like manner as they were increased by unusual exertions.

The decay of the muscular fibres by *rest* is exemplified in all muscles which have not been for some time called into action; and it is extraordinary how greatly the muscles will sometimes diminish in bulk when a limb has been so much injured that it is unable to be moved for even a few weeks. When therefore any of the voluntary muscles are injured, or otherwise diseased, the state of perfect repose into which they are instinctively placed is an essential element in restoring them to health; but the unceasing contractions of the muscles of the heart not only deprives them of the benefit of rest, but becomes an additional stimulus to whatever disorder they may be affected with.

Diminution of the Muscular Tissue of the Heart.

Contrasted with an increase of the parietes of the heart, there are a class of affections wherein the muscular tissue is preternaturally *diminished.* The same demand of the economy to increase the muscular parietes in those persons who are exposed to great muscular efforts not being required in those who lead a sedentary life, the muscular fibres of the heart become diminished, and adipose matter is usually deposited in proportion as the muscular tissue has been wasted.

A diminution in the muscular fibres of the heart is met with in various degrees. In some cases the parietes are so thin as to become transparent, especially of the right auricle, where the bundles of muscular fibres are so few that the exterior and interior membranes are in contact with each other. Bertin.

A diminution in the muscular walls of the heart will be necessarily accompanied with a corresponding diminution of the heart's vigour; and this condition of the central organ may explain many of those cases of feeble circulation, with all its effects on the different systems of the economy, of which we meet with frequent examples.

Case. A lady, of an exceedingly feeble form, and of a nervous temperament, complained for a series of years of great weakness, fits of fainting, approaching to syncope; and she also suffered from symptoms of hysteria. On examining the heart, after her death, there was no deviation from the healthy state apparent, but merely a considerable diminution of its bulk.

Softening of the Muscular Tissue of the Heart.

The muscular parietes of the heart differ not only in the quantity of their fibres, but the fibres present various degrees of consistence, as well as changes in their colour. They often become flaccid, soft, and easily torn; and in place of the bright red colour of the healthy muscle, they are pale, and sometimes portions of them are of a deep crimson colour.

In all organs, and in all tissues, a disorganization and *softening* is one of the effects of acute inflammation; whilst a slow passive inflammation produces an increase in the bulk, or a thickening of the diseased tissue, from additional matter being infused into the parenchyma of the inflamed structure.

That a softening of the muscular parietes of the heart may be caused by inflammation is satisfactorily shown, not only from the febrile character of the symptoms which accompany that change, but also by certain analogous phenomena which are observed in the inflammatory diseases of other organs; and that a thickening of the muscles of the heart should be one of the effects of inflammation, and that a *softening* of them should be another, may appear paradoxical, but it accords with what is constantly remarked in other organs. If a lymphatic gland be affected with chronic inflammation its bulk increases, and it becomes firmer and harder; and these changes may proceed until the gland acquires a very large size; after which, either suppuration, or a process of absorption, may take place; so that the gland ultimately resumes its natural bulk. But if a gland is attacked with violent acute inflammation, and the degree of swelling be comparatively slight, the gland soon loses its vitality and softness, becoming disorganized, and separates from the living parts in the form of a slough.

The inguinal glands frequently afford an illustration of these two very different terminations of inflammation. In one case, the gland becomes hardened and swelled by a very slow inflammatory process, caused by some local or constitutional irritation; and in another case, as sometimes happens in syphilis, a gland in the vicinity of a primary venereal sore, inflames violently, goes through a rapid, but imperfect process of suppuration, the superincumbent integuments sphacetate, and ultimately, the gland, having lost its vitality, separates from the living parts. Changes precisely analagous are observed in inflammatory affections of the alimentary canal. These, when acute, such as those caused by the strangulation of a portion of intestine, if the stricture be not duly removed, the inflamed part softens, and terminates in gangrene; whereas, the peritoneum may be inflamed, and the only morbid change which takes place, is the effusion of fibrine on its surface, and in the sub-serous cellular tissue.

Case.

From these pathological phenomena we may therefore legitimately infer that the muscles of the heart, like all other tissues, when affected with inflammation, swell and thicken in proportion to the passive character of the inflammation, and that they lose their vitality, and soften in proportion to the violence of the inflammatory attack.

CHAPTER XXXII.

MORBID CHANGES OF THE CELLULAR AND ADIPOSE TISSUES.

The morbid changes of the cellular and adipose tissues: differences in the quantity of fat on the heart; its use in the economy; the foramen ovale re-opened; dilatation of the heart; aneurism; rupture and laceration of the heart and aorta; differences in the bulk of the heart; concluding address.

Morbid deposit in the cellular tissue.

IT has been already mentioned that many of the morbid deposits on the heart, which are neither formed in the pericardium, in the endocardium, or in the muscular tissue, are generated in the subserous *cellular tissue*, or in the exterior or interior serous membrane; for there is scarcely any cellular tissue amongst the muscular fibres. It is in the cellular and fibrous tissues, interposed between the duplicatures of the endocardium, in which the various morbid deposits on the valves are formed; and the ossifications on the exterior of the heart are developed in the cellular and fibrous tissues of the pericardium.

The heart has been observed *œdematous;* its cellular tissue, in persons with general anasarca, having the cells infiltrated with a serous fluid, the adipose matter being absorbed. **Bertin.**

Fat, its different quantity on the heart.

The difference in the quantity of *fat* deposited on the exterior surface of the heart of different subjects is very remarkable, and the quantity on the heart bears no proportion to that on the rest of the body,—lean persons having often the largest proportion of fat on the heart; and it is commonly remarked that all those who die with fat hearts are greatly emaciated.

Not only is there a large quantity of fat on the heart when the body is emaciated, but there is often a very unusual quantity when the heart is diseased; deposited not only on the heart's surface, but likewise intermingled with the muscular fibres; and this change sometimes takes place to so great an extent, that the whole muscular parietes appear to be converted into fat. **Adams.**

The use of fat in the economy.

The purposes which the adipose matter serves in the animal economy have never been satisfactorily explained.

On the fœtal heart there is no fat. In most wild animals there is scarcely any fat on the heart; but in domestic animals it is abundant; and in those reared for the food of man, fat is deposited in large quantities on the surface of the pericardium as well as amongst the muscular fibres. In those animals which *hybernate*, the fat with which they have been furnished during summer, is gradually wasted away during the state of hybernation, serving the purpose of their nourishment. And the subcutaneous fat is also of essential use in all animals, to preserve the general heat of the body, and also in protecting the internal organs from cold. The accumulation of fat in the human body proceeds long after the growth of all its other component parts has ceased, rendering it by no means improbable that the additional quantity of fat with which the aged are provided serves as a deposit of nutritive matter. But is the fat which is so often accumulated in a large quantity upon a diseased heart intended as a deposit of an element of nutrition?—and may it not be one of those provisions of which we see so many examples employed by the economy to preserve and restore its different organs? The accumulation of fat on the heart cannot surely cause any of those serious symptoms which some have attributed to it.

How far the elements of fat are changed in diseases, chemical science has not revealed; but, like other component parts of the animal, these elements are probably liable to some morbid changes. In its elementary ingredients, fat seems to vary in different parts of the healthy body; and the rapidity with which the fat of the heart, after being melted, hardens on exposure to cold, may depend on its containing a larger proportion of *stearine* than the fat in other organs.

Changes in the Foramen Ovale.

The *foramen ovale*, so necessary to the fœtal circulation, is, when it remains open after birth, injurious to the circulation of the adult. In this condition the heart resembles that of an amphibious animal; for whenever these creatures plunge into the water, the lungs being no longer wanted as respiratory organs, the venous blood passes directly from the right to the left heart by those channels with which the central organ of the circulation is provided.

"A fœtus being born, cannot live with that heart which served it in the womb; and nature divides the single heart, and there is then a heart for the lungs and a heart for the body. But if any fault in the organization prevent this separation of the heart, if the foramen ovale be preserved open, or if there should be any hole in the septum betwixt the ventricles of the heart; if the pulmonic artery do not admit the blood now that the child is born, and should breathe the air; if the aorta arise from the right ventricle so as to carry off all the blood from the lungs; or if the aorta be so displaced that its mouth stands in part over both ventricles so as to receive the blood of both, then the organization, movements, functions of the heart are all wrong; no blood passes into the lungs, the child cannot live; it either dies immediately in convulsive struggles, or lives in misery but a few years." **John Bell.**

The membrane which covers the *foramen ovale* is sometimes as thin as a spider's web, or it resembles a piece of lace. At other times it is found re-opened in such a manner as to permit an intermixture of the venous and arterial blood. This condition of the *foramen ovale* was first described by Abernethy, but little notice has been taken of it by subsequent pathologists, though its accuracy is corroborated by morbid preparations in every museum. "Having formerly been much surprised to find the heart so little affected when the lungs were greatly diseased, and observing, in one or two instances, that the *foramen ovale* was open, I was led to pay more particular attention to the state of that part, and I have found this to be almost a constant occurrence in those subjects where pulmonary consumption had for some time existed previous to the person's decease. I took notice of this circumstance thirteen times in the course of one year, and, in several instances, the aperture was sufficiently large to admit of a finger being passed through it. Now, as the *septum auriculum* is almost constantly perfect in subjects whose lungs are healthy, I cannot but conclude that the renewal of the *foramen ovale* is the effect of disease—nor will the opinion appear, on reflection, improbable; for the opening becomes closed by the membranous fold growing from one edge of it till it overlaps the other: and their smooth surfaces being kept in close contact by the pressure of the blood in the left auricle, they grow gradually together. But should there be a deficiency of blood in the left auricle, and a redundance in the right, the pressure of the latter on this membranous partition will so stretch and irritate the uniting medium as to occasion its removal, and thus a renewal of the communication between the auricles will take place." Phil. Tr., 1785.

Dilatation of the Heart.

All the heart's cavities may be at the same time dilated, and either the pulmonic or systemic heart, or the auricle or the ventricle of either heart, may be dilated. The auricles are dilated more frequently than the ventricles, and the ventricle of the pulmonic is more frequently dilated than the ventricle of the systemic heart.

The cavities of the heart dilate in various degrees. Sometimes they acquire three or four times their usual size, and, in some instances, particularly in dilatations of the right auricle, they have attained extraordinary dimensions.

The parietes of the dilated heart may either be increased or diminished in thickness, or they remain of their natural dimensions. Accompanying the dilatation of the heart's cavities, the great arterial and venous trunks which emerge from the heart are enlarged, and this causes a corresponding change in the position of the valvular apparatus. The cavities of the heart dilate when there is an obstruction to the free exit of the blood through them, in like manner as the urinary bladder dilates when there is a strictured urethra, or as the stomach enlarges when the pyloric orifice is contracted. And when any of the valves of the heart are diseased, and obstruct the passage of the blood, the cavities situated above them will become likewise dilated.

"That the heart is enlarged merely by weakness, by wanting sufficient power to free itself of accumulating blood, is very plain; for in the plague, in low and pestilential fevers, even in nervous affections, it sometimes enlarges, and from a temporary becomes a mechanical and fixed disease. How often do we read in the preface of such dissections of enlarged heart, 'He was of a melancholy temperament, of a slow and sedentary life, oppressed by misfortunes, and struggling with vexations and grief?'" John Bell.

The physiological symptoms.

The diminished vigour of the circulation in a dilated heart disturbs all the systems of the economy.

The *pulmonary* vessels become congested and cause an embarrassment in breathing, accompanied with a dry *cough*, which usually comes on in severe paroxysms, and is sometimes accompanied with *hæmoptoe*. The lungs, too, are likewise compressed by the enlarged heart.

The dilatation of the right heart is marked by the changes in the *venous* system. The external jugular and veins of the neck and head become enlarged by the reflux of the venous blood from the right auricle. The liver becomes enlarged from a congested state of the potal system, and is frequently accompanied by a hæmorrhoidal flux. The head, neck, and extremities are sooner or later swelled from the infiltration of the cellular tissues.

"The enlarged heart accumulates blood in the system, which before did not exist, and that blood dark coloured and unfit for the purposes of life. The proportion betwixt the great mass of ill-oxydated blood lingering in the veins and about the heart, is increased so very greatly, in opposition to the very small quantity which can now be oxydated in the lungs, that such persons are exposed every moment to the greatest dangers; and the least accident which draws out more black blood from the veins, and hurries it towards the heart, quite overcomes them. Then there is an agonising and fearful struggle; the heart often struggles, and often frees itself; but in most cases those who live in this condition do, after many escapes, fall down suddenly dead.

"In this enlargement of the heart, although sometimes there is a perfect and equal pulse, though sometimes, also, the disease scarcely shows itself until very far advanced, and after many years of slow increase, yet the heart being continually loaded, it cannot free itself at one stroke of all its blood; then, stroke succeeding stroke in a confused irregular way, there is a weak, irregular, intermitting, fluttering pulse.

"But nature, wonderful in her ways, sometimes finds relief from this in the regular constitution of these parts; for while the heart dilates, and becomes more powerless as it dilates, the aorta (being but poorly filled) contracts in proportion as the heart dilates, and accommodates itself to the small quantity of blood which such a heart can give out; and thence the wonder sometimes expressed at finding an aorta extremely slender joined often to an enormous heart." John Bell.

Symptoms. The *impulse* of the heart is diminished in proportion to the thinness of the muscular parietes, and the fluid blood being a much better conductor of sound than the solid walls of the heart, the weaker and thinner the parietes are, the *sounds* will be the more audible, and the more extended will be the surface of the chest over which they can be heard.

Besides being more audible, the character of the sounds is also changed in the dilated heart. The auriculo-ventricular *valves* are so drawn asunder, that they can no longer perform their proper functions, permitting a reflux stream of blood which must necessarily produce changes in the sounds.

Treatment.—The treatment to be employed in dilatation of the heart must necessarily depend on the concomitant changes, and the causes by which they may have been produced. Relief may be obtained not only by bodily and mental tranquillity, but also by having recourse to all those means which invigorate the general system, and which improve the condition of the blood. Hence the advantages of cold-bathing and of breathing a salubrious atmosphere, of attention to diet and regimen, and to the use of stomachics and hæmatics. See Chap. XVI.

Aneurism of the Heart.

The dilatation of the parietes of the heart is sometimes limited to a particular portion of one of its cavities, assuming the form of a pouch, and thus constituting a "true aneurism." Such sacculated tumours are formed by the rupture of the interior laminæ of the heart's parietes. They occur frequently in the *left* ventricle, that cavity being most exposed to inordinate muscular contractions by which it becomes congested, the blood not being able to regurgitate into the pulmonary vessels as when there is a congestion in the right heart, the constriction of the valves in the two hearts being perfectly different. See p. 107.

Aneurisms of the heart have all the general characters of the "true" aneurism of the arteries. They are of various dimensions, and their coats are of various degrees of thickness. The aneurismal pouch is lined by successive layers of fibrine; those contiguous to the interior of the sac are organised, and the exterior laminæ are mixed with coagula of blood.

Symptoms. The presence of an aneurism of the heart, like an aneurism at the neck of the aorta in its very early stage, or when small, may be suspected from its history and symptoms, but cannot be recognised with much certainty. It may be suspected, if the patient had made some very great and unusual muscular effort, or had suffered any violent mental emotion, immediately after which the circulation was disturbed, especially in the head, causing giddiness, vertigo, and syncope.

It is not until the tumour has acquired a certain bulk, that its pulsatory character can be felt, and its whizzing noise becomes audible. In this condition, a class of symptoms are presented, which arise from the aneurismal tumour compressing the adjacent parts. There is a difficulty of swallowing and cough, from its contiguity to the œsophagus and trachea, and pains in the arms and parts around the chest, from its pressure on the spinal nerves.

Treatment.—It is fortunate that the general therapeutic principles which ought to be employed for the treatment of the different morbid changes of the tissues of the heart, are, in most respects, alike. In all of them those means are to be resorted to which tranquillize the heart's movements, for the same reason that rest is recommended as an essential remedy in the treatment of all diseases of the extremities.

This remark strictly applies to the treatment of aneurism. The action of the heart is to be subdued by the abstraction of blood; and, according to the recommendation of Valsalva, the blood should be abstracted only in small quantities, and at sufficient intervals to render the circulation languid. The same purpose will be further obtained by the use of the *tartrate of antimony*, by a low diet, and by the recumbent posture. Immersing the extremities, more especially the superior, into warm water, was strongly recommended by Morgagni; the increased heat of the cutaneous surface thus produced bringing an additional quantity of blood to them from the heart. Diminishing the force of the circulation by these means, not only is the growth of aneurismal swelling diminished, but the coats of the sac are thickened by the deposition of concentric laminæ of *fibrine*, a process of the economy which is accelerated in proportion as the force of the current of the blood in the aneurism is diminished.

Manilluvium.

Rupture of the Heart.

Many examples of a rupture of the heart's parietes are recorded in medical writings; the walls of the heart being sometimes torn by a violent action of their muscles, in like manner as often happens to the uterus, during those violent contractions which take place during difficult parturition.

A rupture of the parietes of the heart usually takes place when some disease of the heart had previously existed; but it occurs also when there had been no evidence of any previous change of structure. The walls of all the different cavities have been found ruptured, but most frequently those of the left ventricle.

When the heart is ruptured, death is occasioned, as in an aneurismal artery, more or less suddenly, according to the size of the fissure; for sometimes the solution of continuity takes place gradually, the effusion of blood into the pericardium is slow; and in some cases the wound is completely filled up by coagulated blood, and ultimately by an effusion of fibrine.

When the parietes of the heart have been ruptured, it has usually happened in persons who had been exposed to some great muscular effort, or violent mental emotion. Running quickly, raising a heavy weight, crying loudly, playing on a wind instrument, falling from a great height, a paroxysm of rage, or excessive grief, have all been known to cause a rupture of the heart.

Rupture of the Valvular Apparatus.

But the same cause which ruptures the parietes sometimes injures other portions of the heart. In some instances the fleshy and the tendinous *columns* are torn asunder, and sometimes the *valves* themselves are lacerated.

Injuries of this description happen not unfrequently. In all those cases where persons have been attacked suddenly with giddiness, reeling, and syncope, after having made some unaccustomed or violent exertion, and in whom the circulation is never afterwards perfectly natural, there is good reason to suspect that one or other portion of the systemic heart has been injured. The valve, torn and displaced, admits a retrograde stream of blood from the ventricle into the auricle; and when any such injury has occurred, the lacerated parts cannot adhere, as they are never in a state of rest; and all that the economy can accomplish is, to effuse fibrine sufficient to fill up, more or less perfectly, the aperture made by the laceration.

Case recorded by Corvisart.

A courier, after having suffered much fatigue from riding on horseback, was attacked with difficulty of breathing and hæmoptoe. Repeated bloodlettings, and other means, afforded no relief. His pulse became very small and contracted, remarkably frequent and irregular; and besides the pulsations of the heart, there was a confused irregular beating, which had no resemblance to the heart's movements. He could not rest in any posture, and "he was in a state of anxiety and agitation impossible to describe." After death, it was discovered that one of the columnæ of the *mitral valve* was torn at its base, thus allowing the valve to float freely in the cavity of the ventricle.

Case II.

A young man made a violent effort to move a great weight, soon after which there came on a cough, palpitations, and sudden startings during sleep. He died twenty months after, having suffered from great anxiety and difficulty of breathing, and severe pains in the region of the heart.

On examining the tendinous columns of the *mitral valve*, two of them were found torn, and all the cavities of the heart were considerably dilated.

Case recorded by Babington.

"A youth received a sudden shock from the unexpected discharge of a pistol close to his ear. He felt conscious that something gave way in his heart, and from that time suffered from palpitation, occasional syncope, with the usual symptoms of obstructed circulation; and he died of general dropsy at the end of eighteen months. The *mitral valve* was found obstructed by a fringe of excrescences, originating from a rupture of the valve itself, which had taken place at the time of the surprise."

Rupture of the Aorta.—When, from any powerful muscular effort, there is a strong regurgitating stream of aortic blood, it has happened that either the semilunar valves are torn, or when they have been able to resist the retrograde stream, the coats of the aorta have given way.

A man fell from a window upwards of forty feet high, and in an hour after he expired. On opening the thorax, the madiastimum was filled with blood, and there were two fissures at the commencement of the descending aorta, through which the blood had escaped. This fig. represents the arch of the aorta, with its three branches, beyond which are two lacerations.

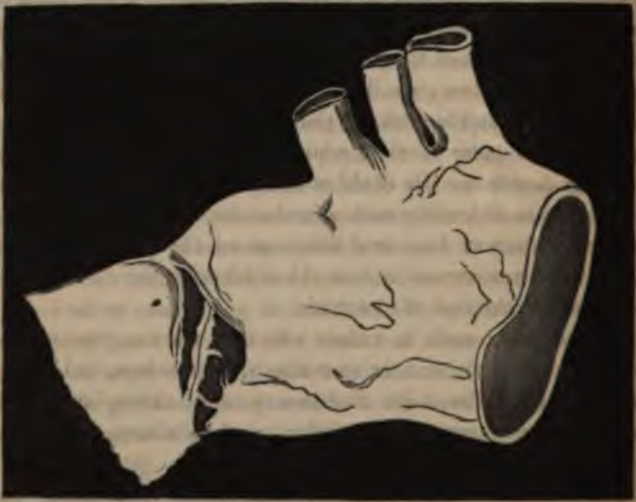

Fig. 16.

Case.

A youth, after a debauch, from which he experienced, on the following day, great weakness and derangement of the stomach, with a view of improving his condition, played at "tennis," which threw him into a profuse perspiration; and on making a violent exertion, he felt suddenly a giddiness and sense of swimming in the head, so that he could not stand or guide himself without difficulty. He was bled at the arm, and notwithstanding every means employed, the same feelings in the head continued, along with a difficulty in breathing and occasional syncope. These symptoms continued, varying in degree, for twelve years, and without any apparent cause he expired suddenly. On inspecting the body, an *aneurism* of the aorta, not larger than a walnut, had burst into the pericardium.

Differences in the size of the Heart.

The differences which are observed in the size of the heart may either depend on original organization, or they may be the effects of disease. "The bulk of the heart in the dead body varies according to the kind of death. There are cases in which the right heart is much contracted, as in those who die from hæmorrhage. In those who have been guillotined, the heart is found remarkably small; and the same is observed in syncope. It is also diminished in size in those who die of phthisis, in consequence of a less than usual quantity of blood. In asphyxia, on the contrary, the bulk of the heart is greatly augmented; and it is the same in the apoplectic. We find in these cases the heart double the size of those who die from hæmorrhage."

Bichat, Anat. Pathologique.

There is considerable variety in the size of the heart at the different periods of life; in different persons of the same age, in those of different stature, and in the different sexes.

Neither is the size of the heart in proportion to the bulk of the body. Fat people, and those who have the least blood, have the smallest hearts; and in muscular men the heart is proportionally large. The heart increases in bulk during the whole period of life, which is contrary to what is observed of other muscles, all of which become enfeebled by age. The comparison that has been made of the heart being of the size of the fist, though it may be applicable at some, cannot be so at all the different periods of life.

Cases.

Laennec.

"In a woman fifty years of age, the heart was found about the size of a child's of twelve years old, and externally it presented the appearance of a withered apple."

"Perhaps," observes John Bell, "the heart may be *too small* for the system to which it belongs; and this, I doubt not, had been the case with that boy in whom Kerkinguis found it so small, that though the boy was nine years old, the heart was no bigger than that of a child's born at the full time."

CONCLUDING ADDRESS.

HAVING brought this Book to a conclusion, I have earnestly to express the hope, that the indulgent reader will not reproach me for its numerous imperfections; and though no one can be more convinced than I am of the many fields of interesting research left unexplored, yet various reasons have compelled me to offer it to my professional brethren in its present state.

"The art of physic is of great extent, life short, opportunity slippery, experience fallacious, and judgment difficult." **Hippocrates.**

The extensive ground over which I have been obliged to travel, the length and the difficulties of the journey have, by no means, been overcome by the years that have been employed, and the pains that I have bestowed to render the work worthy of being offered to the public.

Prosecuting the inquiries connected with the diseases of the heart, they embraced discussions on physiological as well as on pathological subjects, far more comprehensive than I at first contemplated. In every path of research I was met with difficulties. At one time the knife of the anatomist had left some regions imperfectly explored,—the physiologist had given no satisfactory explanation of some of the most important vital phenomena, and the chemist had not minutely ascertained the nature and composition of some parts of the animal fabric.

In fine, I found that in the diseases of the heart every organ, and every system of organs, were more or less influenced, and that a complete Treatise on its maladies, in place of being an isolated subject, should embrace all the elements, and comprise an epitome of medical science.

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